

**"Nutritional requirement of sugarcane genotypes
under different cropping systems"**



Thesis

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**G.B. Pant University of Agriculture and Technology, Pantnagar
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By

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DEDICATED TO
MY
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DR. S.K. SAINI

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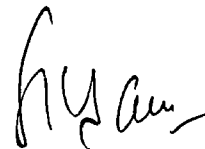
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CERTIFICATE

This is to certify that the thesis entitled " **NUTRITIONAL REQUIREMENT OF SUGARCANE GENOTYPES UNDER DIFFERENT CROPPING SYSTEMS**", submitted in partial fulfillment of the requirements for the degree of **Doctor of Philosophy** with major in **Agronomy** and minor in **Soil Science** of the College of Post-Graduate Studies, G.B.Pant University of Agriculture and Technology, Pantnagar, is a record of *bona fide* research carried out by **Mr. Sarnam Singh**, Id. No. **25839**, under my supervision, and no part of the thesis has been submitted for any degree or diploma.

The assistance and help received during the course of this investigation have been acknowledged.



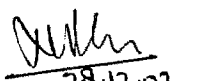
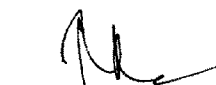
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We, the undersigned, members of the Advisory Committee of **Mr. Sarnam Singh**, Id. No. 25839, a candidate for the degree of **Doctor of Philosophy** with major in **Agronomy** and minor in **Soil Science**, agree that the thesis entitled "**NUTRITIONAL REQUIREMENT OF SUGARCANE GENOTYPES UNDER DIFFERENT CROPPING SYSTEMS**", may be submitted in partial fulfillment of the requirements for the degree.

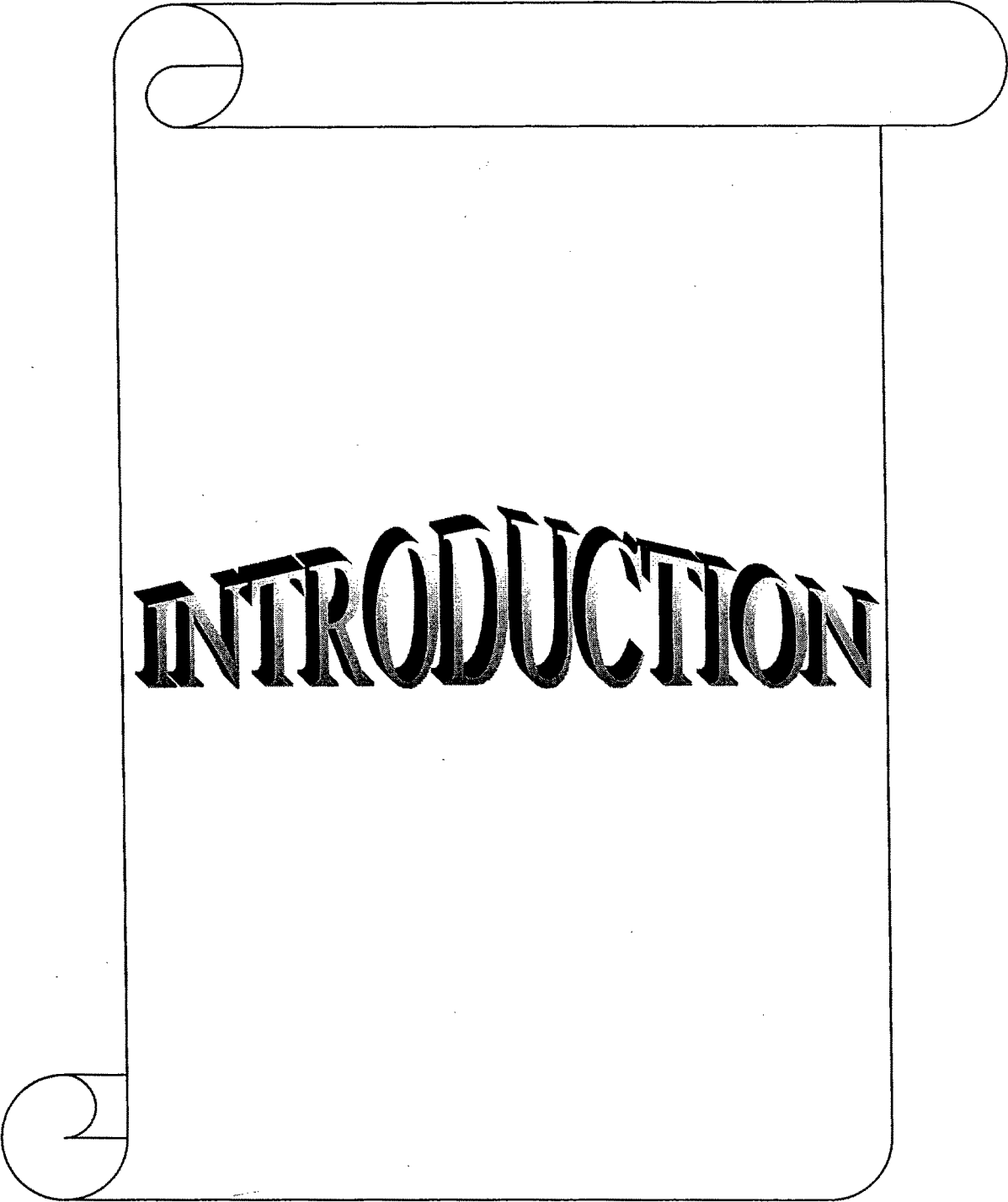


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INTRODUCTION

1. INTRODUCTION

India is one of the largest producers of sugar and has neck to neck race with Brazil. The country shares 4.1 and 13.3 per cent of the Asian's and world's sugar production, respectively. Sugarcane, being an agro-industrial crop is integral component of the Indian agriculture. It assumes important position in the Indian economy contributing 2.0 per cent of the national GDP.

Sugarcane crop sustains second largest agro-industry viz. sugar industry after textile. Sugarcane is cultivated over 4.0 million hectare under varied agro-ecological conditions. India is producing 300 million tonnes of cane with 18.0 million tonnes of centrifugal sugar (Shahi, 2002). The productivity of cane in India is low, being 72.0 tonnes per hectare as compared to other efficient sugarcane growing countries. The analysis of sugarcane productivity trend revealed that cane yield throughout the country is almost stagnant. However, in certain states like Maharashtra, Tamil Nadu, Punjab and Haryana, there has been decline in the productivity. Besides socio-economic constraints, one of the significant reasons of yield decline is an intensive cultivation coupled with inadequate nutrients supply causing deterioration in soil fertility. As a result, most of the Indian soils have turned deficient in nitrogen, and deficiency of phosphorus and potassium are emerging in soil and plants on large scale.

There are several factors responsible for low cane productivity and production like large soil and climatic variations, biotic and abiotic stress and in-

-judicious use of chemical fertilizer. Apart from soil and climate, fertilizer requirement of the sugarcane crop may vary with genotypes, crop sequences/planting seasons. There are two sugarcane planting seasons viz., autumn and spring in north India. Autumn (October) season crop yields 15-20 per cent more than spring season but cropping intensity is low. Hence, planting of sugarcane in autumn season with suitable intercrop viz. lahi, potato, mustard and/or lentil is recommended. Spring (February-March) is the main planting season of sugarcane in north India following mustard, potato and late paddy. Another dominant planting time/season of sugarcane in western Uttar Pradesh and lower parts of Uttaranchal is planting of sugarcane in April/May following wheat, lentil and/or mustard. Though the cane productivity under wheat-sugarcane sequence is lower but area under this sequence is increasing as a result of small land holding. The cropping intensity under this cropping system is, maximum (150 per cent).

Like other crops, large genotypic variations exist in sugarcane, which may provide lead in increasing cane yields. Further genotypes might differ in their yield potential and juice quality under different planting seasons. It may not be true that a variety yielding higher in plant crop would also perform equally good in ratoon crop.

Several workers (Singh *et al.*, 1996) worked out the fertilizer requirement of the sugarcane crop under different planting seasons. However, limited information is available on fertilizer requirement of sugarcane in relation to crop

sequences. Therefore, keeping above considerations in view, a field experiment entitled “Nutritional requirement of sugarcane genotypes under different cropping systems” was planned and conducted at the Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttaranchal), with the following main objectives :

1. To study the effect of cropping systems on growth, yield and quality of sugarcane.
2. To study the genotypic differences with respect to growth, yield and quality of sugarcane.
3. To study the fertilizers requirements of sugarcane genotypes under different cropping systems.
4. To study the cropping systems, genotypes and fertility interactions, if any in relation to yield and quality of sugarcane.

**REVIEW
OF
LITERATURE**

2. REVIEW OF LITERATURE

In the present chapter, efforts have been made to collect pertinent information on the effect of varieties, planting seasons / crop sequences and fertilizer levels on the performance of sugarcane crop.

2.1 Varietal differences in relation to crop growth

Cerbo *et al.* (1990) studying varietal differences in relation to number of shoots observed that cultivar Phil 6607 produced significantly higher number of shoots than Phil 56226. Devi *et al.* (1990) working at the Regional Agriculture Research Station, Anakapalle, noted that variety Co 6907 produced significantly higher number of shoots (106.9 thousand ha⁻¹) than Co 8341 (89.9 thousand ha⁻¹), Co 8338 (82.2 thousand ha⁻¹) and Co 8339 (76.9 thousand ha⁻¹). Jain *et al.* (1990) observed that variety CoS 767 attained significantly higher shoot height than Co 419, Co 66-17, Co 1007, Co 7317, Co 6304 and Co 8001. Mishra and Naidu (1990) working at Regional Research Centre, Sugarcane Breeding Institute, Uchani (Karnal), reported that variety Co 7008 exhibited significantly higher shoot height than Co 8349 and CoJ 64. Singh *et al.* (1991) working at Ghagharaghat, Bharaich, reported that variety Co 8118 produced more tillers (224.0 thousand ha⁻¹) than CoS 7918 (174.0 thousand ha⁻¹), Bo 91 (166.0 thousand ha⁻¹), CoS 8009 (131.0 thousand ha⁻¹) and CoS 767 (144.0 thousand ha⁻¹). Hapase *et al.* (1995) from, VSI, Pune, reported that varieties Co 87025 and Co 87023 attained significantly

higher shoot height than Co 87017 and Co 87219. Buragohain (1996) from Buralikson (Assam) revealed that cultivars CoBLN 9101 and CoBLN 9102 were significantly superior to Co 8327 and Co 740 in plant height, cane girth and number of millable canes. Goswami and Singh (1996) observed significantly higher number of millable canes in cultivars CoBLN 20/84 than CoBLN 9104.

Suharno (1998) from Indonesia, reported that individual cane weight were higher in cultivar PS 80-960 and PS 83-4981 than other cultivars. Azzazy and Elham (2000) working at the Experiment Station at Giza (Egypt) noted that G 85-37 was superior to G 84-47 in plant height. Azzazy *et al.* (2000) from Egypt, observed that cultivar G.T. 54-9 exhibited superiority in stalk height and stalk diameter over F-153 and G 74-96.

Ramesh (2000) from Coimbatore, observed that cultivar Co 6304 produced higher dry matter than Co 8208. Singh *et al.* (2000) observed that genotype CoS 96268 was superior to CoS 687 and CoJ 64 in terms of millable canes, stalk height, cane diameter and individual cane weight.

Singh *et al.* (2000) revealed that average cane weight, cane girth, cane length and millable canes were significantly higher in cultivar Co1148 than CoS 767, CoS 687 and CoJ 64. Tamilselvan and Giridharan (2000) from Regional Research Station, Paiyur (Tamil Nadu), noted that among seven sugarcane genotypes tested, genotype Co90025 recorded the higher number of millable canes and shoot height than other genotypes.

2.2 Varietal differences in relation to crop yield

Devi *et al.* (1990) working at Regional Agriculture Research Station, Anakapalle, reported that variety Co 8341 exhibited significantly higher cane yield (106.9 t ha^{-1}) than Co 8341 (89.9 t ha^{-1}). Jain *et al.* (1990) from Udaipur (Rajasthan), noted that variety Co 8001 produced significantly higher cane yield (126.9 t ha^{-1}) than that of Co 419 (120.1 t ha^{-1}), Co 66-17 (118.4 t ha^{-1}) and Co 1007 (118.1 t ha^{-1}). Studies made by Mishra and Naidu (1990) at Karnal, revealed variety Co 8211 produced significantly higher cane yield (79.5 t ha^{-1}) than CoJ 64 (38.3 t ha^{-1}).

Patel *et al.* (1990) from Navasari (Gujarat), reported that variety Co 8338 had significantly higher cane productivity (138.4 t ha^{-1}) than Co 8339 (128.4 t ha^{-1}) and Co 8341 (124.8 t ha^{-1}). Rangiah (1990) reported that Co 8114 gave the highest cane yield (155.6 t ha^{-1}) among several genotypes studied. Singh *et al.* (1991) observed that variety CoS 8118 produced higher number of millable canes (178.0 thousand ha^{-1}) and cane yield (83.0 t ha^{-1}) than CoS 8009. Djojosewardho (1994) from Pasuruan (Indonesia), observed that variety PS 80-960 produced significantly higher cane yield than other varieties including PS 77-1553 and PS 80-933. More *et al.* (1994) from Kolhapur (Maharashtra), revealed that genotype CoC 671 exhibited significantly higher cane yield (112.2 t ha^{-1}) than other genotypes.

Nigade *et al.* (1994) while studying the varietal differences in cane yield at Sugarcane Research Station, Padagaon (Maharashtra), reported that variety

CoM 7125 produced significantly higher cane yield than other varieties including Co 7527 and CoC 671. Santo (1994) revealed that genotypes PS 78-8294 and PS 80-847 exhibited significantly higher cane yields (i.e. 91.3 t and 97.0 t ha⁻¹, respectively) than PS 80-1649. Hapase *et al.* (1995) from Vasantdada Sugar Institute, Maujari (Pune), observed that varieties Co 87023 and Co 87260 exhibited significantly higher number of millable canes and cane yield than Co 7219. Khandagave and Satpute (1995) found that variety CoC 92061 and Co 8013 were significantly superior to CoC 671, Co 85004, Co 6907, Co 85009 and Co 7704 in cane yield.

Das *et al.* (1996) reported that genotype Co 6304 produced significantly higher cane yield (123.7 t ha⁻¹) than other genotypes. Goswami and Singh (1996) found that CoBLN 9104 produced highest, cane yield (77.9 t ha⁻¹) followed by CoBLN 20/84 (73.5 t ha⁻¹) and Co 8014 (68.8 t ha⁻¹). Hasabnis *et al.* (1996) noted that variety Co 88011 produced significantly higher cane yield (106.4 t ha⁻¹) than Co 740 and Co 7527. Shushila *et al.* (1996) from Karnal, reported that cultivar Co 89034 gave highest cane yield (89.6 t ha⁻¹) than Co 89003 (80.2 t ha⁻¹), Co 88042 (55.9 t ha⁻¹). Ramesh and Mahadevaswamy (1997) from Sugarcane Breeding Institute, Coimbatore, opined that variety Co 86010 gave the highest cant yield (109.8 t ha⁻¹) than Co 86011 and Co 85002.

Rao *et al.* (1997) from Anakapalle (A.P.), reported that cane yield ranged from cultivar 85A-261 and Co6907 yielded (71.3) and 82.5 t ha⁻¹, respectively. Verma *et al.* (1997) observed that genotype Co 7805 produced significantly

higher cane yield (102.0 t ha^{-1}) than Co 1305 (98.7 t ha^{-1}) and Co 79.04 (91.8 t ha^{-1}). Ramesh (2000) from Coimbatore, observed that variety Co 6304 gave significantly higher cane yield than Co 8208. Ramdoyal *et al.* (2000) from Reduit (Mauritius), revealed that variety M 1400 186 produced significantly higher cane yield than M 1394/86 and R 579.

Rao and Rao (2000) working at the Sugarcane Research Station, Rudrur (A.P.), reported that cultivars Co 7219 recorded significantly higher cane yield than 85 R 186. Selvan *et al.* (2000) working at Regional Research Station, Paiyur (T.N.), observed that genotype CoV 92102 was more promising than others in cane yield.

2.3 Varietal differences in relation to juice quality

Devi *et al.* (1990) from Anakapalle, reported that variety Co 6907 had significantly higher sucrose content (16.4 per cent) than Co 8338 (15.9 per cent) and Co 8339 (15.8 per cent). Mishra and Naidu (1990) observed that variety Co 8334 accumulated highest sucrose (19.2 per cent) and purity (88.2 per cent) followed by Co 8301 (16.6 per cent sucrose and 86.3 per cent purity). Mishra and Naidu (1990) reported that variety Co 83211 gave significantly higher commercial cane sugar (9.9 t ha^{-1}) than CoJ 64 (4.9 t ha^{-1}). Mishra (1991) from Karnal, reported that varieties Co 8209 and Co 8402 exhibited significantly higher juice sucrose than Co 7708.

Mishra (1991) opined that variety Co 8211 produced statistically higher Jaggery (9.1 t ha^{-1}) than Co 8204 (8.5 t ha^{-1}). Malik *et al.* (1993) reported that

Punjab cultivar BF 162 gave the higher sugar yield (10.1 t ha^{-1}) than Co 1148 (8.6 t ha^{-1}). Ahmad *et al.* (1995) noted that genotype Si 85036 had the highest sugar yield (15.5 t ha^{-1}) followed by Co 92061 (15.4 t ha^{-1}) and CoC 671 (14.3 t ha^{-1}). Altaf *et al.* (1995) from Sugar Crops Research Institute, Mardan (Pakistan), reported that genotype 75/1353 gave highest sugar yield among several genotypes tested. Kathiresan and Ayyamperumal (1996) reported that genotypes CoG 94077 and Co 86010 recorded higher sugar yield than CoC 92061. Goswami and Singh (1996) observed that highest commercial cane sugar was recorded in CoBLN 55/77 (14.2 per cent) followed by CoBLN 9104 (14.0 per cent) and Co 8014 (13.8 per cent).

Mehla *et al.* (1997) found that sugar yield of cultivars CoH 56, CoH 92, CoH 99 and CoH 108 were comparable to cultivar CoS 767, but content of commercial cane sugar was higher 11.4 to 13.8 per cent) than CoS 767. Muhadjir (1998) observed that crystal sugar production was significantly higher in varieties PS 88-3268 and PS 88-4046 than PS 88-8922. Babu *et al.* (2000) from Sugarcane Research Station, Vuyyuru (Tamil Nadu), reported that cultivar Co 8148 produced significantly higher sugar yield and juice sucrose than Co 7219. Jadhav *et al.* (2000) from Kolhapur, Maharashtra, observed that highest sugar yield (18.55 t ha^{-1}) was given by cultivar Co 7527 among other varieties tested.

Quintero *et al.* (2000) observed that cultivar CC 85-92 gave higher sugar yield and commercial cane sugar than PR 61-632. Singh and Singh (2000) from

Sugarcane Research Station, Shahjahanpur, reported that cultivar CoS 95255 was significantly superior to others in sugar yield and commercial cane sugar production. Singh and Singh (2000) noted that variety CoS 96268 had significantly higher sugar recovery than other varieties including CoS 9527, CoSe 95426, CoS 97248, CoSe 98231 and CoJ 83.

2.4 Effect of planting season on growth

Choudhary *et al.* (1996) from Brazil, reported that growth parameters viz. shoot height, fresh weight and number of tillers per shoot at various growth stages were significantly affected by planting season. Rana *et al.* (1999) from Pantnagar, revealed that autumn cane + mentha exhibited significantly higher shoot population and number of millable canes than sole crop. Singh (1999) from Sugarcane Research Institute, Pusa (Bihar), reported significantly higher millable canes (92.2 thousand ha⁻¹) were recorded in November planted cane than April planted (72.2 thousand ha⁻¹). Hussain *et al.* (2000) from Tichur, revealed that higher dry matter production and number of shoots were recorded in sole crop than intercropped with sugarcane.

2.5 Effect of planting season on yield

Ahmad and Rajasekaran (1993) revealed that significantly higher cane yield was obtained from planting in December (129.4 t ha⁻¹) and January (129.5 t ha⁻¹) planted crops than in February and March planting. Shivay and Rathi (1996) found that autumn cane intercropped with mustard yielded 53.0 t/ha against 50.3 t/ha in sole cane. Swamy *et al.* (1996) from experiments conducted

at Anakapalle (A.P.), observed that early planted crop gave higher cane yield than the late planted.

Rana *et al.* (1999) reported that autumn planted sole cane produced highest cane yield, being 71.0, 14.9 and 45.0 per cent higher than preceded by wheat and mustard and autumn + wheat, respectively.

Singh (1999) from Sugarcane Research Institute, Pusa (Bihar), reported that November planted crop produced 22.2 and 71.0 per cent higher cane yield than February and April planted crop respectively.

Singh (2000) from Kunraghat (Gorakhpur) reported that cane yield was higher (104.9 t ha^{-1}) in October planting than February and April planting.

2.6 Effect of planting seasons on juice quality

Sudama and Dua (1990) from the experiments conducted on planting seasons (February to May) concluded that delaying planting after mid February significantly decreased sugar yield. However cane juice sucrose content under February, March, April and May planting seasons were 18.52, 19.17, 18.21 and 17.72 per cent, respectively. Ramesh and Mahadevaswamy (1997) found that February planting gave significantly lower sugarcane yield and commercial cane sugar yield than planting in October and December. Singh *et al.* (1997) reported that sugar yield was significantly higher with autumn planting than spring or summer planting.

2.7 Interaction between varieties and planting season

Sukhchain and Thind (1997) working at the Experiment Station, Roper (Punjab), observed that autumn season planted crop gave higher commercial cane sugar yield, whereas spring season planted crop gave lower commercial cane yield. Ramesh and Mahadevaswamy (1996) working at the Sugarcane Breeding Institute, Coimbatore found that sugarcane genotypes Co 85002, Co 85004, Co 86010 and Co 86011 were planted in October, December or February. Variety Co 86010 gave the highest sugar content than other varieties.

Ramdoyal *et al.* (2000) observed that under mid season planted variety M 1400/86 accumulated significantly higher sugar whereas under late planting exhibited R-579 higher cane yield and best suited for mid and late planting. Godwa *et al.* (2001) reported that genotype Co 7704 planted in September and highest sugar yield was recorded. However, brix (21.5 per cent) and pol (20.0 per cent) were significantly higher with September planted than January planted cane. Shafshak *et al.* (2001) from Zagazing, Egypt, reported that brix per cent, sucrose per cent, fiber per cent and reducing sugar contents was significantly affected by the planting seasons.

2.8 Fertilizers effect

2.8.1 Effect of nitrogen on growth

Jayabal and Chockalingam (1990) working at the Sugarcane Research Station, Melalathur (TN) revealed that tillers production (224.9 thousand ha⁻¹) and number of millable canes (113.0 thousand ha⁻¹) were significantly higher at

375 kg nitrogen ha⁻¹ than that of 0, 125 and 250 kg nitrogen ha⁻¹. Jayabal and Shankaran (1991) from Coimbatore, observed that tillers production and shoot height were higher with higher levels of nitrogen Prasad *et al.* (1991) observed that number of tillers and plant height increased significantly with increasing nitrogen levels upto 180 kg N ha⁻¹. Sharma and Gupta (1991) noted that dry matter production increases with increasing nitrogen levels. Gholve *et al.* (1993) working at the Sugarcane Research Station, Padegoan (Maharashtra) found that the highest number of millable canes (87 thousand ha⁻¹) was produced with 300 kg nitrogen ha⁻¹. Verma *et al.* (1997) working at Sehore, noted that shoot height (1.9 m), cane diameter (2.73 cm) and number of millable cane (82.1 thousand ha⁻¹) were significantly higher at 300 kg nitrogen ha⁻¹ than at 150 and 225 kg N ha⁻¹. Mahadevaswamy (1996) from Sugarcane Breeding Institute, Coimbatore, reported that shoot population (108.8 thousand ha⁻¹) and number of millable canes (60 thousand ha⁻¹) were significantly higher with 400 kg N ha⁻¹ than 100 and 200 kg N ha⁻¹. Verma and Verma (1996) working at the Indian Institute of Sugarcane Research, Lucknow, noted that number of tillers (279.2 thousand ha⁻¹), millable canes (106.2 thousand ha⁻¹), cane length (232 cm) and cane diameter (2.2 cm) were significantly higher at 200 kg N ha⁻¹ than that of 50, 100 and 150 kg N ha⁻¹. Singh (1999) from Shahjahanpur, reported that cane height significantly increased with higher doses of nitrogen upto 175 kg N ha⁻¹. Buragohain (2000) working at the Experiment Station at Buralikson (Assam) noted significantly higher cane height (2.7 m), cane diameter (2.5 cm) and

number of millable canes (91.6 thousand ha⁻¹) with 135 kg N ha⁻¹ than that of 101.3 kg and 67.5 kg N ha⁻¹.

2.8.2 Effect of nitrogen on yield

Devi (1990) reported that increasing nitrogen doses upto 168 kg ha⁻¹ significantly increased cane yield. Durai *et al.* (1990) from Cuddalore, noted that increasing nitrogen levels upto 325 kg ha⁻¹ significantly increased cane yield. Jayabal and Chockalingam (1990) working at the Experiment Station at Melalathur (T.N.) observed that crop fertilized with 250 kg nitrogen ha⁻¹ produced significantly higher cane yield (98.8 t ha⁻¹) than that of 125 kg N ha⁻¹. Kumaraswamy and Rajasekaran (1991) working at Experiment Station Cuddalore, observed that crop fertilized with 280 kg nitrogen ha⁻¹ gave higher cane yield than lower levels. Yadav and Kumar (1992) from Indian Institute of Sugarcane Research, Lucknow, noted that cane yield increased with increasing levels of nitrogen upto 225 kg ha⁻¹. Kapoor *et al.* (1993) P.A.U., Ludhiana reported that cane yield significantly increased with application of 150 kg nitrogen ha⁻¹.

Singh *et al.* (1996) from Shahjahanpur, noted that cane yield was significantly higher (75.2 t ha⁻¹) with 225 kg N ha⁻¹ than 75 and 150 kg N ha⁻¹. Swamy *et al.* (1996) working at the Regional Agricultural Research Station, Anakapalle (AP), reported that crop receiving 200 kg N ha⁻¹ produced significantly higher cane yield (84.5 t ha⁻¹) over 50 and 100 kg N ha⁻¹. Verma and Verma (1996) working at the Sugarcane Research Station, Sehore (M.P.),

noted that cane yield recorded with 300 kg N ha⁻¹ was highest (78.2 t ha⁻¹). Buragohain (2000) working at the Experiment Station, Buralikson, reported significantly higher cane yield (95.3 t ha⁻¹) and commercial cane yield (11.8 t ha⁻¹) with 135 kg N ha⁻¹ than that of 101.3 and 67.5 kg N ha⁻¹. Singh *et al.* (2000) noted that crop fertilized with 225 kg nitrogen ha⁻¹ produced higher cane yield (104.7 t ha⁻¹) than lower levels.

2.8.3 Effect of nitrogen on quality

Kumaraswamy and Rajasekarn (1990) from Cuddalore, reported that juice quality was unaffected with increasing nitrogen levels from 80 to 120 kg N ha⁻¹. Jayabal and Chockalingam (1990) working at the Experiment Station, Melathur, observed that commercial cane sugar (12.5 %) and sugar yield (12.8 t ha⁻¹) were significantly higher at 250 kg nitrogen ha⁻¹ over 125 kg N ha⁻¹. Banger and Sharma (1992) from Sehore, observed that commercial cane sugar increased upto 300 kg nitrogen ha⁻¹. Yadav and Kumar (1992) from IISR, Lucknow, found non-significant difference in pol and purity per cent with increasing nitrogen application upto 150 kg ha⁻¹. However, reducing sugar increased significantly with increasing rate of nitrogen application. Sharma and Gupta (1991) working at the Agricultural Research Station, Kota (Rajasthan) noted that increasing levels of nitrogen upto 250 kg N ha⁻¹ significantly increased juice extraction but decreased quality parameters. Narasimhan and Ramalingam (1991) noted that sugar yield (18.6 t ha⁻¹) increased significantly with increasing nitrogen levels upto 112 kg ha⁻¹. Kapoor *et al.* (1993) from Jalandhar, reported that sugar yield

and reducing sugars in juice increased upto 150 kg nitrogen ha⁻¹. Banger *et al.* (1994) working at Experiment Station, Sehore, noted that cane yield was highest with 300 kg N ha⁻¹ (104.8 t ha⁻¹) but quality attributes such as juice brix, sucrose, purity (ash and cane) and fibre decreased with increasing in nitrogen levels upto 300 kg ha⁻¹.

Neema *et al.* (1995) working at Sehore, found that sugar yield increased with nitrogen levels (250 kg N ha⁻¹) but sucrose content in juice decreased with increased nitrogen levels. Studies made by Swamy *et al.* (1995) at Anakapalle, reported that increased in nitrogen levels up to 224 kg ha⁻¹ significantly increased in sugar yield (10.6 t ha⁻¹). Verma (1995) working at the Experiment Station at Sehore, observed that brix (20.7 %), sucrose (18.6 %) and commercial cane sugar (12.2 t ha⁻¹) were significantly higher at 300 kg nitrogen ha⁻¹ than that of 150 and 225 kg N ha⁻¹. Banger (1996) working at Sehore, reported that brix (21.1 %), and reducing sugars (0.63 %) significantly increased with increasing N from 150 to 225 kg ha⁻¹. However, juice pH decreased significantly with increased nitrogen levels upto 225 kg N ha⁻¹. Mahadevaswamy (1996) working at the Experiment Station, Coimbatore, noted significantly higher sugar yield (8.7 t ha⁻¹) at 300 kg N ha⁻¹ over 100 and 200 kg N ha⁻¹.

Singh *et al.* (1996) working at the Sugarcane Research Institute, Pusa, revealed that sucrose content (17.5 %) in juice decreased with increasing nitrogen levels upto 150 kg ha⁻¹. Verma (1995) working at Experiment Station,

Sehore, noted that quality parameters did not differ significantly with increasing nitrogen levels upto 300 kg ha^{-1} .

Quintero and Garcia (1998) working at the Experiment Station, Colombia, found that higher levels of nitrogen (150 kg N ha^{-1}) decreased sugar production. Sathyavallu *et al.* (1999) working at the Sugarcane Research Station, Cuddalore, reported that application of 275 kg N ha^{-1} did not affect commercial cane sugar but reducing sugar content increased with increasing nitrogen rate. Buragohain (2000) from Buralikson, noted significantly higher commercial cane sugar yield (11.8 t ha^{-1}) with 135 kg N ha^{-1} than that of 101.3 and $67.5 \text{ kg N ha}^{-1}$. Singh *et al.* (2000) from A.S. College, Lakhoati (U.P.), reported that cane quality was not affected by nitrogen upto 225 kg N ha^{-1} . Tamilselvan (2001) working at Experiment Station, Paiyur, observed that crop fertilized with 225 kg N ha^{-1} gave better juice quality than that of 281 kg N ha^{-1} .

2.8.4 Effect of phosphorus on growth

Jayabal and Chockalingam (1990) from Sugarcane Research Station, Melalathur, reported that cane germination was influenced by graded doses of phosphorus application. Patil and Shingte (1990) from Navsari, noted that germination did not improve by the phosphorus application upto 165 kg ha^{-1} . Rahman *et al.* (1992) from Bangladesh, reported that tillers production increased with increasing phosphorus levels from 50 to 100 kg ha^{-1} . Jayabal and Chockalingam (1990) from Melalathur noted that tillering and shoot height were not increased by phosphorus application. Patil and Shingte (1990) working at the

Experiment Station, Navsari, found that number of shoots were not influenced by phosphorus application.

2.8.5 Effect of phosphorus on yield

Patil and Shingte (1990) observed that cane yield and yield attributes were not increased by phosphorus application upto 165 kg ha^{-1} at Navasari (Gujrat). Hussain *et al.* (1991) reported that phosphorus alone had very little effect on cane yield and yield attributes. Patel *et al.* (1991) working at Experiment Station, Navasari, indicated that higher cane yield with increasing phosphorus levels. Rahman *et al.* (1992) from Bangladesh, noted that cane yield increased with higher doses of phosphorus $120 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$. Kumaraswamy and Rajasekaran (1993) from Cuddalore, reported that cane yield increased with increasing phosphorus levels upto 80 kg ha^{-1} . Sachan *et al.* (1993) working at Pantnagar, noted that cane yield was not influenced by different phosphorus levels (upto 80 kg ha^{-1}) in the Tarai soil. Patel *et al.* (1993) from Navsari, observed that cane yield significantly increased due to phosphorus application.

Sathyavellu and Rajasekaran (1994) working at Sugarcane Research Station, Cuddalore, indicated that yield and yield attributes were significantly improved with phosphorus application upto $83 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$. Vijay *et al.* (1999) from Karnal, observed that cane yield (92.6 t ha^{-1}) significantly increased with $50 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$. Babu *et al.* (2000) working at Sugarcane Research Station, Vuyyuru noted that cane yield (119.3 t ha^{-1}) was significantly higher with $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$.

2.8.6 Effect of phosphorus on quality

Jayabal and Chockalingam (1990) from Experiment Station, Melalathur (T.N.) reported that crop fertilized with 32 kg P_2O_5 ha⁻¹ yielded significantly higher sugar yield but attained lower CCS per cent. Patel *et al.* (1991) from Navsari, noted significant improved in commercial cane sugar and sucrose per cent due to phosphorus application upto 125 kg P_2O_5 ha⁻¹. Kumaraswamy and Rajasekaran (1993) from Cuddalore, observed that phosphorus application upto 80 kg/ha did not alter juice quality. Sathyavellu and Rajasekaran (1994) working at Vuyyuru, noted that commercial cane sugar per cent and sugar yield were not improved significantly due to phosphorus application. Sundara (1996) working at the Sugarcane Breeding Institute, Coimbatore, noted highest sugar content (12.9 per cent) with 80 kg P_2O_5 ha⁻¹. Vijay *et al.* (1999) working at the Regional Research Station, Karnal, found that commercial cane sugar and sucrose content were not significantly affected by 50 kg ha⁻¹. Babu *et al.* (2000) from Vuyyuru, observed that application of 75 kg P_2O_5 ha⁻¹ decreased juice sucrose.

2.8.7 Effect of potassium on growth

Patil and Shingte (1990) from Kolhapur, found that application of 200 kg K_2O ha⁻¹ resulted in better crop growth in terms of higher tillers and cane height. Jamuna *et al.* (1994) working at the Experiment Station, Anakapalle, noted significant improved in tillering at 150 kg K_2O ha⁻¹. Vijay *et al.* (2000) from Regional Research Station, Karnal, reported that application of potassium from

50 to 125 kg K_2O ha⁻¹ significantly improved cane height and number of internodes per cane.

2.8.8 Effect of potassium on yield

Choudhary and Rahman (1990) noted that application of 70 kg K_2O ha⁻¹ significantly increased cane yield 78.2 t ha⁻¹ over lower levels of potassium. Said Rahman *et al.* (1990) from Bangladesh, reported that cane yield increased with increasing K_2O rates. Patil and Shingte (1990) from Kolhapur, observed that crop fertilized with 110 and 165 kg K_2O ha⁻¹ recorded significantly higher cane yield (107.5 t ha⁻¹) than that of cane the lower doses of 55 kg K_2O ha⁻¹. Yadav (1993) from, IISR, Lucknow, observed that yield response to each kilogram of soil applied K_2O over control varied from 0.10 to 3.52 quintals under irrigated condition. Jamuna *et al.* (1994) working at Anakapalle noted that application of 150 kg K_2O ha⁻¹ significantly increased cane yield over 0 and 75 kg K_2O ha⁻¹. Dang *et al.* (1995) from Uchani (Karnal) increasing cane yield upto 62.2 kg K_2O ha⁻¹. Rathore *et al.* (1996), noted highest cane yield (93.6 t ha⁻¹) with 100 kg of K_2O ha⁻¹ applied as basal.

2.8.9 Effect of potassium on quality

Said Rahman *et al.* (1990) observed that potassium levels did not significantly affect commercial cane sugar. Patil and Shingte (1990), reported that application of 110 and 165 kg K_2O ha⁻¹ resulted in significantly higher sugar yield than that of lower doses of 55 kg K_2O ha⁻¹. Singh *et al.* (1992) working at Pusa (Bihar) found that sucrose, purity coefficient increased but fibre per cent

decreased significantly with potassium application upto 50 kg K_2O ha⁻¹. However, Dhillon *et al.* (1993) noted that potassium application did not affect sugar yield. Jamuna *et al.* (1994) working at Anakapalle, observed that application of 150 K_2O ha⁻¹ significantly increased sugar yield and juice quality over no potassium application.

Subramanian (1994) noted highest sugar yield from the crop fertilized with at 125 kg K_2O ha⁻¹. Dang *et al.* (1995) working at the Karnal, reported that increasing potassium levels improved quality of cane juice in term of juice, brix and sucrose. Prasad *et al.* (1996) noted that brix per cent, commercial cane sugar per cent, pol, purity per cent of cane juice and sugar yield increased significantly upto 60 kg K_2O ha⁻¹. Rathore *et al.* (1996) working at the Sugarcane Research Station, Sehore, observed that juice brix and sucrose per cent were highest in 100 kg K_2O ha⁻¹ applied in sugar cane crop.

2.8.10 Effect of integrated nitrogen, phosphorus and potassium application on growth, yield and quality

Ingawale *et al.* (1992) observed that application of 250 kg N, 110 kg P_2O_5 and 110 kg K_2O ha⁻¹ resulted in higher dry matter production (38.1 t ha⁻¹) than that of 250 kg N, 55 kg P_2O_5 and 55 kg K_2O ha⁻¹. Banger *et al.* (1995) from Sehore, found that cane height (286 cm), cane diameter (2.9 cm) and number of millable canes (98.3 thousand ha⁻¹) were significantly higher at 375 kg N, 100 kg P_2O_5 and 75 kg K_2O ha⁻¹ than that of lower doses (150-300 kg

N, 40-80 kg P_2O_5 and 30-60 kg K_2O ha^{-1}). Mahboob *et al.* (2000) working at the Experiment Station, Faisalabad, reported that cane length and cane girth were higher with 250 kg N + 100 kg P_2O_5 + 100 kg K_2O ha^{-1} than lower levels (200 kg N + 75 kg P_2O_5 + 75 kg K_2O ha^{-1}) of fertilizers. Ali *et al.* (2001) from Faisalabad, noted that application of N : P_2O_5 : K_2O in the ratio 2.5 : 1.0 : 1.0 (250 : 100 : 100 kg ha^{-1}) gave significantly higher total biomass yield.

Jayabal and Chockalingam (1990) working at the Experiment Station, Melalathur, observed significantly increased in cane yield due to application of 250 kg N and 32 kg P_2O_5 ha^{-1} . Dhillon *et al.* (1993) from Ludhiana, noted significant increase in cane yield upto 150 kg N and 60 kg P_2O_5 ha^{-1} . Sathyavallu *et al.* (1999) working at Sugarcane Research Station, Cuddalore, found that cane yield significantly increased with 275 kg N and 25 kg P_2O_5 ha^{-1} . Jafri *et al.* (1991) from Indian Institute of Sugarcane Research, Lucknow, noted highest cane yield with 150 kg N and 50 kg K_2O ha^{-1} . Rao *et al.* (1995) found highest cane yield (68.7 t ha^{-1}) from 150 kg N and 100 kg K_2O ha^{-1} applied crop. Singh *et al.* (1992) working at B.H.U., Varanasi, noted that cane yield of 60.3 t ha^{-1} could be recorded with 120 N : 40 P_2O_5 : 40 K_2O kg ha^{-1} . Banger (1995) working at Sehore, found higher cane yield of 102.5 t ha^{-1} with 375 N + 100 P_2O_5 + 75 K_2O kg ha^{-1} than that of lower levels (300 N + 80 P_2O_5 + 60 K_2O kg ha^{-1}). More *et al.* (1995) observed that crop fertilized with 250 N, 115 P_2O_5 , 115 K_2O kg ha^{-1}

yielded significantly higher cane yield than that of other levels of fertilizers.

Gangwar and Sharma (1997) from Modipuram (Meerut), noted that sugarcane yield was highest (55.3 t ha^{-1}) with $160 \text{ N} : 60 \text{ P}_2\text{O}_5 : 40 \text{ K}_2\text{O kg ha}^{-1}$. Reddy and Ahmed (1998) reported that highest sugarcane yield of 100.0 t ha^{-1} with 290 N , $109 \text{ P}_2\text{O}_5$ and $104 \text{ K}_2\text{O kg ha}^{-1}$. Yadav (1999) working at the IISR, Lucknow, noted that crop receiving 25 per cent more fertilizer over recommended ($150 \text{ N} : 100 \text{ P}_2\text{O}_5 + 50 \text{ K}_2\text{O kg ha}^{-1}$) dose produced higher cane yield than 100 and 75 per cent recommended fertilizers. Faqir *et al.* (2000) from Faisalabad, noted that cane yield was highest (131.6 t ha^{-1}) with $200 \text{ N} : 150 \text{ P}_2\text{O}_5 : 150 \text{ K}_2\text{O kg ha}^{-1}$. Ramesh *et al.* (2000) working from Trichur, reported significantly cane yield (97.6 t ha^{-1}) at $165 \text{ N} : 85 \text{ P}_2\text{O}_5 : 85 \text{ K}_2\text{O kg ha}^{-1}$. Vashishtha and Sinha (2000) from Sugarcane Research Institute, Pusa, found that crop fertilized with higher doses of fertilizers (187.5 N , $40 \text{ P}_2\text{O}_5$ and $40 \text{ K}_2\text{O kg ha}^{-1}$) produced significantly higher cane yield (83.1 t ha^{-1}) than that of lower levels (112 N , $40 \text{ P}_2\text{O}_5$ and $40 \text{ K}_2\text{O kg ha}^{-1}$).

Rao *et al.* (1995) noted that application of 150 kg N and $100 \text{ kg K}_2\text{O ha}^{-1}$ produced highest sugar yield of 10.9 t ha^{-1} . Banger (1995) working of Sugarcane Research Station, Sehore, noted significantly higher sugar yield (12.5 t ha^{-1}) with $375 \text{ N} + 100 \text{ P}_2\text{O}_5 + 75 \text{ K}_2\text{O kg ha}^{-1}$ than that of lower levels (300 N , $80 \text{ P}_2\text{O}_5$ and $60 \text{ K}_2\text{O kg ha}^{-1}$). Ingawale *et al.* (1992) reported that application of 250 N , $55 \text{ P}_2\text{O}_5$ and $55 \text{ K}_2\text{O kg ha}^{-1}$ produced cane crop of

highest juice brix and sucrose content. However, Ramesh *et al.* (2000) working at Experiment Station, Trichur, noted that various levels of N, P and K failed to influence the cane juice quality in term of brix, pol, commercial cane sugar and sugar yield.

2.9 Nutrient uptake

Sugarcane crop producing heavy tonnage, removes a good amount of plant nutrients from the soil. There are number of factors including cropping systems, genotypes and fertility levels etc. which directly or indirectly affect nutrients uptake by the crop.

Singh and Jafri (1990) observed that leaf sheath phosphorus content increased due to application of phosphorus and exhibited a gradual decline towards maturity. Phosphorus requirement for each tonne of cane has been estimated to vary from 0.25 to 0.67 kg by Yadav (1993). Lestari (1993) reported that optimum sugar production was achieved when phosphorus content in leaves and juice was 0.43 and 0.25 per cent, respectively under Jawa conditions. Pereira *et al.* (1995) working in Brazil noted a linear relationship between cane yield and phosphorus content of leaves.

Singh and Kekhon (1990) noted that crop fertilized with $150 \text{ kg K}_2\text{O ha}^{-1}$ removed 318 kg of potassium per hectare, being significantly higher over no potassium application. An increasing trend in potassium uptake with increasing levels of potassium fertilization upto $100 \text{ kg K}_2\text{O ha}^{-1}$ has also been noted by Singh *et al.* (1992). Yadav (1993) reported that sugarcane crop required 1.95-

2.57 kg K for producing a tonne of millable canes under irrigated conditions at Lucknow. Jamuna *et al.* (1994) found significant and linear increase in potassium content of 3rd to 6th sheath at different stages of crop growth upto 225 kg K₂O ha⁻¹ beyond which it remained constant upto 300 kg K₂O ha⁻¹. Tiwari *et al.* (2000) observed an increasing trend in potassium uptake by sugarcane with increasing potassium levels under score conditions.

Kumaraswamy *et al.* (1992) noted that cane crop significantly responded to nitrogen at 120 and phosphorus at 0 kg P₂O₅ ha⁻¹, while the response to potassium application was not significant. Inagwale *et al.* (1992) while working at Rahuri, Maharashtra recorded highest sugarcane dry matter yield (38.1 t ha⁻¹) with 250 kg N + 110 kg P₂O₅ and 110 kg K₂O as against 25 t ha⁻¹ with 250 kg nalene. Juice brix and sucrose were observed to be highest with application of 250 kg N + 55 kg P₂O₅ + 55 kg K₂O ha⁻¹ juice purity was not affected by NPK application.

Verma *et al.* (1991) from Uchani, Kernal, reported that phosphorus applied to plant crop had a residual effect on the ratoon crop. Kumaraswamy and Rajasekaran (1993) noted that cane yield of ratoon crop was not significantly affected by phosphorus rate applied in plant crop at Cuddalore (T.N.). Patel *et al.* (1993) while studying the phosphorus requirement of sugarcane ratoon crop sequence noted that 125 kg phosphorus is need annually for I ratoon and 62.5 kg to the second to get maximum yield. Verma and Dang (1995) from Karnal, reported that highest cane and sugar yields and net returns were obtained with

direct application to phosphorus to the ratoon as compared with residual phosphorus.

Tiwari *et al.* (2000) noted that available soil potassium increased with increasing potassium application. Kumar *et al.* (2000) recorded an increase in potassium availability with the application of 50 and 75 kg K₂O ha⁻¹ over control at Karnal. Verma *et al.* (1995) while working at Uchani, Karnal observed that potassium applied to plant crop had no effect on yield of ratoon cane.

Shankaraiah *et al.* (2000) found that enhanced uptake and higher tissue indices of phosphorus besides nitrogen and potassium were indicative of better nutrients use efficiency and positive influence on various aspects. Prado and Ferhendes (2001) revealed that nitrogen, phosphorus and potassium uptake affected by application of nutrients in the crop. Poonkodi and Angayarkauri (2001) from Annamalainagar, reported that phosphorus uptake at 40 days after planting (DAP) increased from 4.73 g per pot in the control treatment to 12.8 g per pot. Tamilselvan (2001) found that the application of 281 kg nitrogen ha⁻¹ increased soil nitrogen availability and the uptake of N, P and K compared with the recommended rate of 225 kg nitrogen ha⁻¹. Soil phosphorus and potassium were lower with 281 kg than 275 kg nitrogen ha⁻¹.

**MATERIALS
AND
METHODS**

3. MATERIALS AND METHODS

The details of the experimental materials used, procedures followed and techniques adopted during the course of investigation are described in this chapter.

3.1 Experimental details

3.1.1 Experimental site

The field experiments were conducted during 1998-2000 and 1999-2001 in the I₅ block of the Crop Research Centre at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Udham Singh Nagar), Uttaranchal. The Crop Research Centre is situated at 29°N latitude, 79.3°E longitude and at an altitude of 243.8 meters above the mean sea level. Pantnagar is located in the Tarai region in foot hills of Shivalik range of Himalayas.

3.1.2 Climate

The Crop Research Centre falls in the humid and sub-tropical zone with summer being very hot and dry and winter very cold. The frost occurs in winter generally from last week of December to end of January. The monsoon commences in the second or third week of June and continues till the end of September. Few showers are also expected during winter season.

The mean monthly weather data recorded during the crop period at meteorological observatory located at the Crop Research Centre, Pantnagar are depicted in Figure 1 and Appendix-I. The mean maximum temperature during 1998-2000 ranged from 17.7 to 38.0°C and during 1999-2001 from 18.3 to

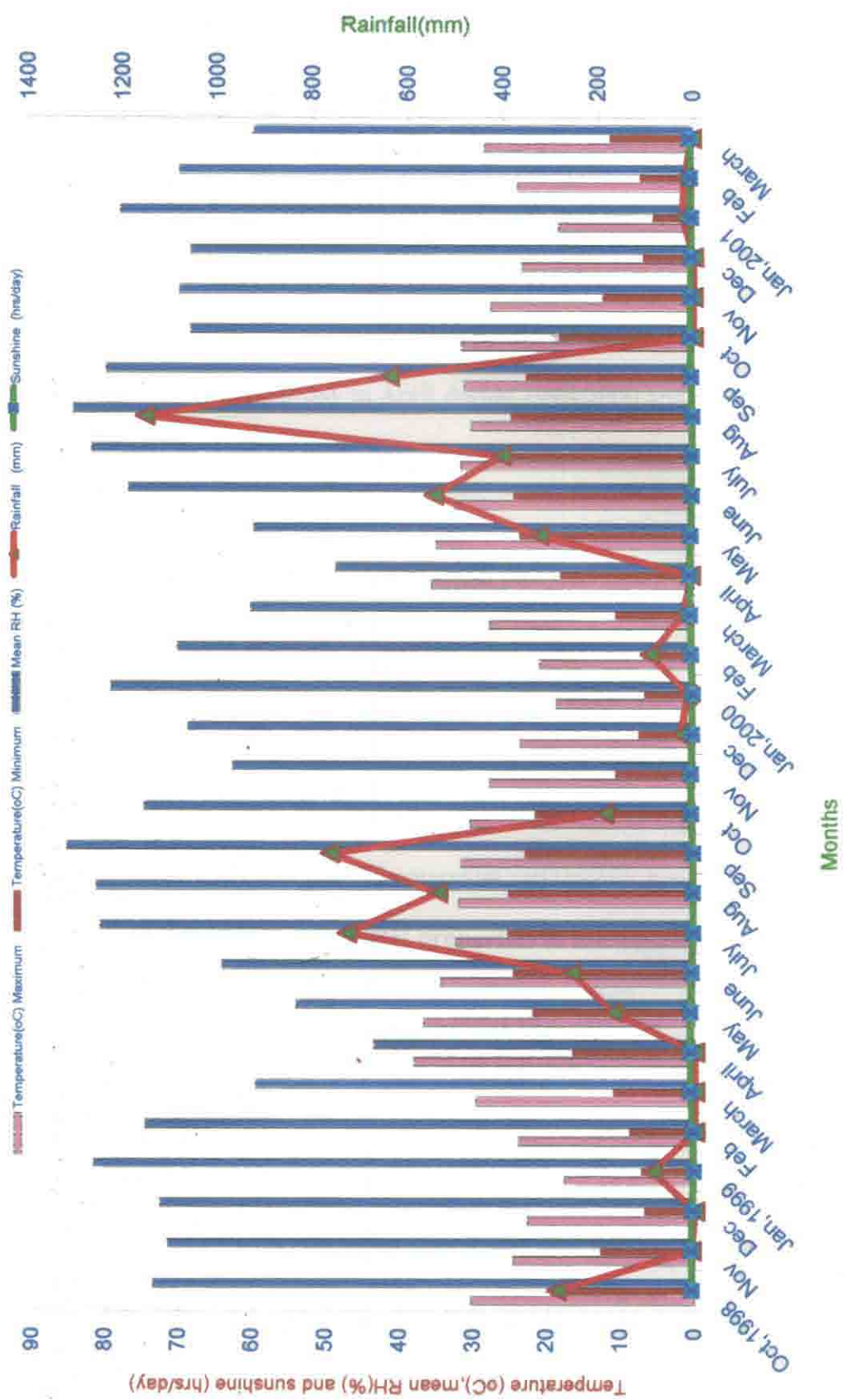


Fig.1: Meteorological data recorded during the cropping season

35.6°C in January and April. The mean minimum temperature fluctuated from 6.9°C in January to 25.4°C in July and 5.6°C in January to 25.3°C in July during 1998-2000 and 1999-2001, respectively. The mean relative humidity varied from 43.5 to 85.0% and 48.5 to 84.0 per cent during two crop seasons, respectively. The total rainfall recorded during two crop seasons were 3222.0 and 3487.4 mm of which 2303.5 and 2750.2 mm were received during monsoon season (June to September). The mean sunshine period varied from 3.6 hours per day in January to 10.2 hours per day in April during 1998-2000 and 4.9 hours in January to 10.3 hours in April in 1999-2001 crop seasons.

3.1.3 Soil

The soil of the experimental plot was classified under order Mollisol; sub-order-udoll, great group-Hapludoll, sub-group-Aquic Hapludoll and soil series-Khamia, silty loam (Deshpande *et al.*, 1971). The composite soil sample from 0-15 cm depth was taken from the experimental field for chemical analysis before planting. The soil was silty loam, rich in organic carbon and medium in available phosphorus and potassium and neutral in reaction (Table 1).

Table 1. Physico-chemical properties of the experimental soil

Particulars	Value obtained		Method of determination
	1998-2000	1999-2001	
Soil texture	Silty clay loam		Deshpande <i>et al.</i> (1971)
Organic carbon (%)	1.12	1.15	Modified Walkley and Black Method (Jackson, 1973)
Total nitrogen (%)	0.085	0.090	Modified Kjeldahl's Method (Jackson, 1973)
Available phosphorus (kg P ha ⁻¹)	12.5	12.9	Olsen's Method (Olsen <i>et al.</i> , 1954)
Available potassium (kg K ha ⁻¹)	270.0	275.0	Ammonium Acetate Method (Hanway and Heidel, 1952)
pH (1:2.5, soil and water suspension)	7.3	7.5	Beckman Glass Electrode pH Meter Method (Jackson, 1973)

3.1.4 Cropping history of the experimental plot

The crop history of the experimental plot is given in Table 2.

Table 2. Cropping history of the experimental field

Year	
1998-2000	1999-2001
Sugarcane	Sugarcane
Sugarcane ratoon - Green Manure	Sugarcane ratoon - Green Manure
Experimental sugarcane crop	Experimental sugarcane crop

3.1.5 Experimental details

3.1.5.1 Treatments

A. Cropping Systems	Symbol used
1. Autumn Sugarcane + Mustard (Divya)	S ₁
2. Mustard (PR-15) - Spring Sugarcane	S ₂
3. Wheat (UP 2338) - Late Spring Sugarcane	S ₃
B. Genotypes	
1. CoPant 90223 (Mid)	V ₁
2. CoPant 92226 (Early)	V ₂
3. CoPant 93227 (Mid)	V ₃
C. Fertilizer Levels	
1. 75 % of recommended N PK	F ₁
2. 100 % of recommended NPK (120:80:40 kg ha ⁻¹)	F ₂
3. 125 % of recommended NPK	F ₃

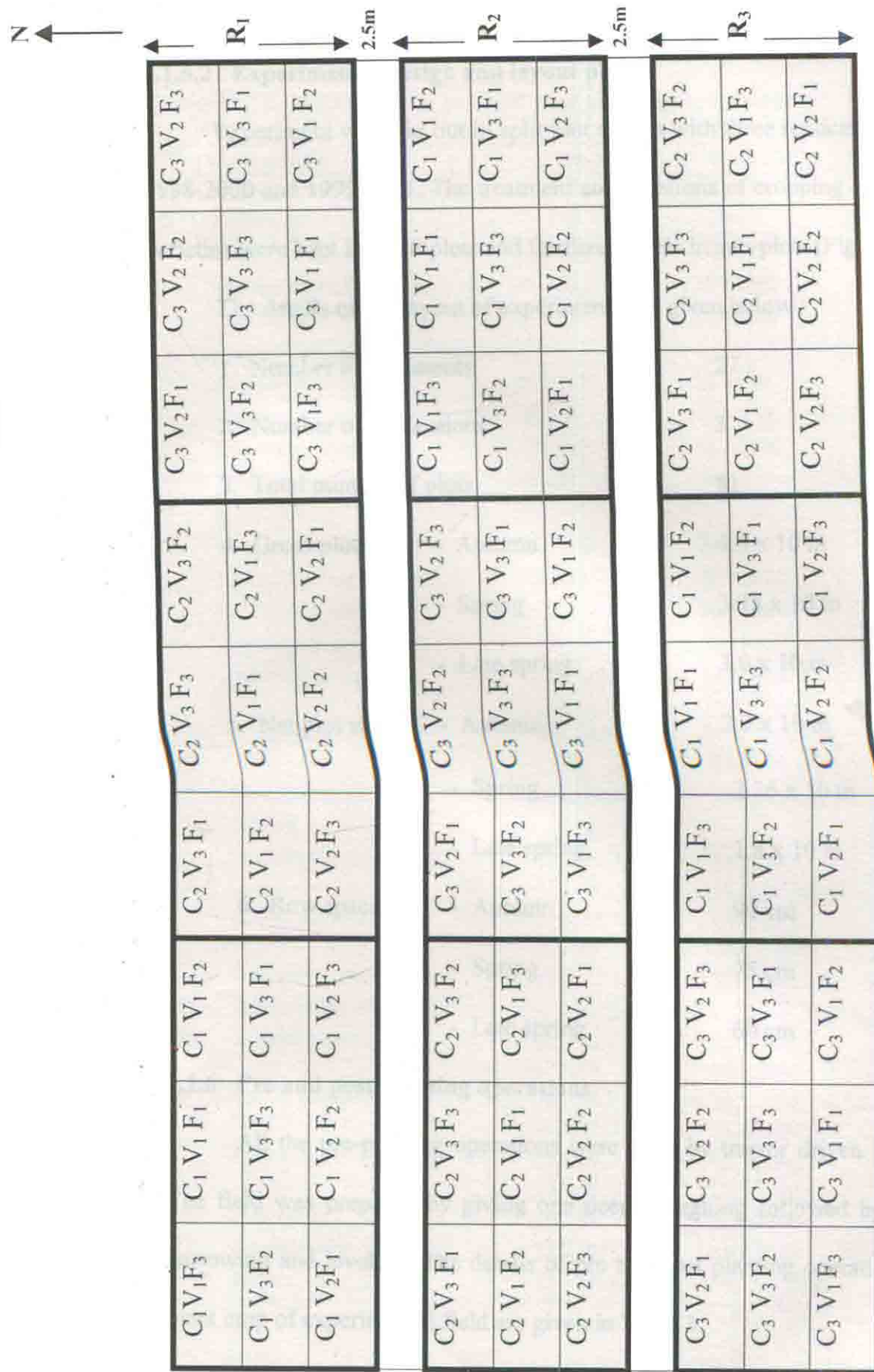


Fig. 2: Layout plan of the field experiment

3.1.5.2 Experimental design and layout plan

Experiment was laid out in split plot design with three replications during 1998-2000 and 1999-2001. The treatment combinations of cropping systems and varieties were kept in main-plots and fertilizer levels in sub-plots (Figure 2).

The details of the layout of experiments are given below :

1. Number of treatments	:	27
2. Number of replications	:	3
3. Total number of plots	:	81
4. Gross plot size - Autumn		4.5 x 10 m
- Spring		3.75 x 10 m
- Late spring		3.0 x 10 m
5. Net plot size - Autumn		2.7 x 10 m
- Spring		2.25 x 10 m
- Late spring		1.8 x 10 m
6. Row spacing - Autumn		90 cm
- Spring		75 cm
- Late spring		60 cm

3.1.6 Pre and post planting operations

All the pre-planting operations were done by tractor driven implements. The field was prepared by giving one deep ploughing followed by two cross harrowing and levelling. The details of pre and post planting operations done in plant crop of experimental field are given in Table 3.

Table 3. The details of the pre and post planting operations

S.No.	Operations	1998-2000	1999-2001	Remarks
1.	Layout of the field experiment	19.10.98	25.10.99	
2.	Furrow opening			
	Autumn planting	20.10.98	24.10.99	<i>Tractor</i> Driven ridger
	Spring planting	20.3.99	26.3.2000	
	Late spring planting	15.4.99	18.4.2000	
3.	Planting and covering of setts			Manually
	Autumn planting	20.10.98	24.10.99	
	Spring planting	20.3.99	26.3.2000	
	Late spring planting	15.4.99	18.4.2000	
4.	Fertilizer application (P & K)	Basal	Basal	Manually
5.	Bund making			Manually
	Autumn planting	25.10.98	28.10.99	
	Spring planting	25.3.99	29.3.2000	
	Late spring planting	20.4.99	24.4.2000	
6.	Irrigations			Manually
	Autumn planting (5)	15.2, 20.3, 15.4, 10.5, 30.5.99	19.2, 16.3, 5.4, 30.4, 20.5.2000	
	Spring planting (3)	30.4, 20.5, 5.6.99	20.4, 15.5, 8.6.2000	
	Late spring (2)	20.5, 10.6.99	25.5, 15.6.2000	
7.	Hoeing			Manually
	Autumn planting (4)	25.2, 15.3, 5.4, 25.4.99	28.2, 20.3, 10.4, 20.4.2000	
	Spring planting (3)	20.4, 15.5, 10.6.99	25.4, 20.5, 15.6.2000	
	Late spring planting (2)	15.5, 15.6.99	25.5, 10.6.2000	
8.	Top dressing of urea			Manually
	Autumn planting	20.3.99 13.5.99	12.3.2000 20.5.2000	
	Spring planting	20.5.99 10.6.99	18.5.2000 12.6.2000	
	Late spring planting	25.5.99 15.6.99	28.5.2000 21.6.2000	
9.	First tying	17.8.99	12.8.2000	Manually
	Second tying	25.9.99	19.9.2000	Manually
10.	Harvesting	15-17.3.2000	13-15.3.2000	Manually

3.1.7 Seed materials and planting

Seed canes of varieties CoPant 90223, CoPant 92226 and CoPant 93227 were taken from the healthy crop. Canes were cut in to three budded sett pieces. The selected sett pieces were dipped in 0.25 per cent emmison solution for 15 minutes just prior to planting to protect the cane setts from fungal infection if any. The furrows of 15 cm depth were opened with the help of tractor mounted furrow opener. Treated setts were planted in furrows at the rate of four setts per meter of furrow length. Furrows were covered immediately with loose soil with the help of spade and finally field was planked with the help of tractor drawn planker to maintain good seed pieces soil contact.

3.1.8 Fertilizer application

Urea (46 % N), single super phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O) were used as sources of nitrogen, phosphorus and potassium, respectively. Half of the nitrogen and full dose of phosphorus and potassium were applied as basal in furrows and remaining nitrogen was top dressed in the month of March (after harvest of intercrop) and May in autumn planted cane and incase of spring and late spring planted crop nitrogen was applied in the month of May and June following irrigations.

3.2 Observations

3.2.1 Growth studies

3.2.1.1 Per cent germination

The number of sprouts from each net plot was counted at 30 and 45 days after planting. The germination per cent was calculated as :

$$\text{Per cent germination} = \frac{\text{Number of sprouts per net plot}}{\text{Number of buds planted per net plot}} \times 100$$

3.2.1.2 Shoot population

The number of shoots per net plot was counted at monthly interval from March to August in autumn planted cane and in case of spring planted crop from April to August. However, in late spring planted crop shoot count was made in May and August and computed on hectare basis.

3.2.1.3 Shoot height

Five randomly selected shoots from each net plot were tagged. The height of all the five shoots was measured from base of the stem to the tip of the top most leaf with the help of metre tape at monthly interval from March to August in autumn planted cane and from June to August in spring planted crop. In late spring planted cane crop shoot height was measured in July and August. The average height of shoot was calculated on the basis of five shoots.

3.2.2 Growth analysis

The above five plants taken for height from each plot were further used for growth analysis.

3.2.2.1 Leaf area

All the leaves from a sample of five shoots were categorized into three groups i.e. large, medium and small and counted separately. Three leaves from each category were selected randomly and their length and breadth were

measured. The average area of one leaf for each category was calculated as follows :

$$\text{Leaf area per shoot} = \frac{a + b + c}{5} \times 0.65$$

Where,

a = Total number of large leaves x mean leaf area of a large leaf

b = Total number of medium leaves x mean leaf area of a medium leaf

c = Total number of small leaves x mean leaf area of a small leaf

3.2.2.2 Leaf area index (LAI)

The leaf area index was calculated by following relationship.

$$\text{LAI} = \frac{\text{Total leaf area per plant (m}^2\text{)}}{\text{Area occupied per plant (m}^2\text{)}}$$

3.2.2.3 Dry matter accumulation

Shoot taken from all the plots were chopped in to small pieces and fresh weight was recorded. A representative sample of 500 g for cane and 200 g for leaves was kept for drying in a drier at 70°C±1 for 72 hours to get constant weight. Total dry weight per shoot was computed for each component on the basis of fresh weight.

3.3 Studies at harvest

The crop was harvested from ground level. The green and dry leaves were separated out and millable canes, after discarding dry and diseased canes, were pooled plot wise and the following studies were made.

3.3.1 Number of millable canes

The canes from each net plot were counted and their number was calculated on hectare basis.

3.3.2 Length of canes

Representative sample of five canes from each net plot was taken. The length of individual cane was measured with the help of measuring tape and averaged.

3.3.3 Number of internodes per cane

The canes used for recording length were also used for observation on number of internodes per cane. All the internodes of five canes were counted and averaged.

3.3.4 Average cane weight

The weight of all five canes were taken and averaged.

3.3.5 Cane girth

The diameter of each cane was measured with the help of a Vernier Callipers at three points i.e. bottom, middle and top; summed up and averaged. The average diameter of cane was multiplied by 3.142 for computing the cane girth.

3.3.6 Yield

3.3.6.1 Cane yield

The crop was harvested from ground level and green and dry leaves were

stripped off. The weight of millable cane per net plot was recorded with the help of plate form balance and yield per hectare was computed on the basis of net plot.

3.3.6.2 Green top yield

Weight of green top per net plot was recorded and yield per hectare was computed on the basis of net plot.

3.3.6.3 Trash yield

The weight of dry leaves per net plot was taken and yield per hectare was worked out.

3.3.6.4 Biological yield

The biological yield of crop was computed by adding all the three yield component i.e. cane, green top and trash, and expressed on hectare basis.

3.4 Juice analysis

A sample of five canes was taken randomly from each plot and following quality parameters were studied from December to March at monthly interval.

3.4.1 Juice extraction

The cane samples after recording their weight were crushed separately and juice weight was recorded. The per cent juice extraction was calculated using following formula.

$$\text{Juice extraction per cent} = \frac{\text{Weight of juice extracted}}{\text{Weight of cane crushed}} \times 100$$

3.4.2 Juice brix

Brix value was recorded by using Brix hydrometer dipped in a measuring cylinder filled with cane juice. Temperature correlations were made to correct observed brix reading by using temperature correction as described by Spencer and Meade (1955).

3.4.3 Juice sucrose

About one hundred ml of juice was taken in conical flask and one g lead acetate was added to it. The impurities were filtered through Whatman number 42 paper. Filtrate was taken in a 20 ml polarimeter tube to record pol reading with the help of Polarimeter following Horne's Dry Lead Acetate Method with dilute solution as described by Spencer and Meade (1955). Schmitz's table was used to calculate the juice sucrose.

3.4.4 Reducing sugar

The filtrate juice used for pot reading was also used to determine reducing sugars. Ten milliliter of Fehling's solution (5 ml of Fehling's A and 5 ml Fehling's B) was titrated against filtrate juice using methylene blue indicator. Invert sugar table 47 for ten ml of Fehling's solution was referred for further calculations (Spencer and Meade, 1955) to compute reducing sugars in cane juice.

3.4.5 Juice purity

The juice purity was calculated considering sucrose and brix content of the juice as following :

$$\text{Purity per cent} = \frac{\text{Sucrose per cent in juice}}{\text{Corrected brix}} \times 100$$

3.4.6 Available sugar in cane juice

Available sugar per cent in cane at harvesting was computed using the following formula (Spencer and Meade, 1955).

$$\text{Available sugar per cent} = [S - \{0.4 (B-S)\} 0.73]$$

Where,

S = Sucrose per cent in juice

B = Corrected brix of juice

3.4.7 Commercial cane sugar (C.C.S.)

The commercial cane sugar per hectare at harvesting was worked out as follows :

$$\text{C.C.S. (t ha}^{-1}\text{)} = \frac{\text{Available sugar per cent in cane}}{100} \times \text{Cane yield (t ha}^{-1}\text{)}$$

3.5 Nutrients uptake

Uptake of nitrogen, phosphorus and potassium were determined in cane, green leaves and trash at harvesting stage in both the years.

3.5.1 Nitrogen

A sample of five canes from each plot were taken, chopped and weighed. Sample of five hundred g cane was kept in oven at $70 \pm 1^\circ\text{C}$ for 72 hours and dry weight was recorded. Similarly in green leaves and trash samples of two hundred was kept in oven at $70 \pm 1^\circ\text{C}$ for 72 hours and dry weight was recorded. Nitrogen

content in plant parts was determined by following Micro-Kjeldahl's Method (Jackson, 1973). These observations were recorded in March, April, May, June, July and August in autumn planted cane, in June, July and August in Spring planted cane and in July and August in late spring planted cane crop. The total uptake of nitrogen in green top, trash and cane was calculated by multiplying nitrogen concentration in the tissue and dry weight of different plant parts.

3.5.2 Phosphorus

A sample of cane from each plot was taken, chopped and weighed. Five hundred gram of chopped material of cane and two hundred gram of green leaves and trash were dried in drier at $70\pm 1^{\circ}\text{C}$ for 72 hours and their dry weight was recorded. Phosphorus content in the different plant parts was determined following Vanadomolybdo-phosphoric yellow colour method (Jackson, 1973). Total uptake of phosphorus in green top, trash and cane was calculated by multiplying phosphorus concentration in the tissues and dry weight of the different plant parts. Samples were collected in March, April, May, June, July and August in autumn planted cane. In spring planted cane crop observations were recorded in June, July and August, whereas in late spring planted cane crop observation were recorded in July and August.

3.5.3 Potassium

A sample was collected from each plot, chopped and weighed. Five hundred gram of chopped materials of cane, two hundred gram leaves and trash was dried in oven at $70\pm 1^{\circ}\text{C}$ for 72 hours. Potassium content in the different

plant parts was determined by Neutral Ammonium-Acetate Method (Hanway and Heidal, 1952). The total uptake of potassium in green top, trash and cane was calculated by multiplying potassium concentration in the tissue and dry weight of the different plant parts. Samples were collected in March, April, May, June, July and August in autumn planted cane. In spring planted cane observations were recorded in June, July and August, whereas in late spring planted cane observations were recorded in July and August.

3.6 Statistical analysis

The experimental data obtained during the course of investigations were subjected to statistical analysis. The technique of analysis of variance (ANOVA) prescribed for split plot design to test of significance of the differences among treatments mean by the 'F' test significant the critical difference (C.D.) at 5 % probability (Cocharan and Cox, 1959).

3.6.1 Standard error of means

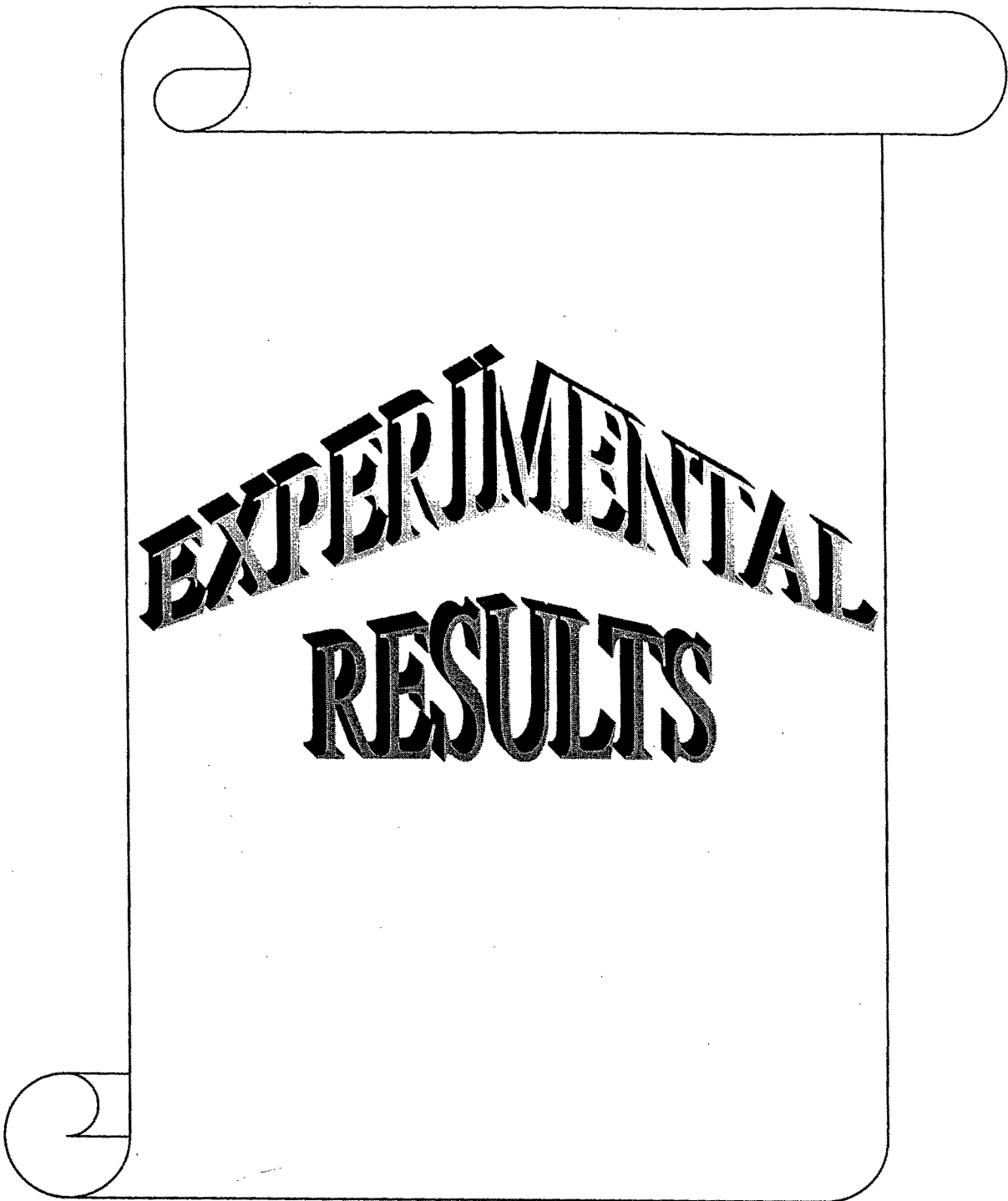
Standard error of mean was calculated by the following formula :

$$S.E.m. \pm = \sqrt{\text{Error mean sum of square} / \text{number of replications}}$$

3.6.2 Critical differences

When 'F' test value from analysis of variance table was significant the critical difference was worked out at 5 % level of probability using following formula for comparing the two treatment means.

$$C.D. \text{ at } 5 \% = \text{Standard error of mean} \times \sqrt{2} \times t \text{ at error degree of freedom.}$$



EXPERIMENTAL RESULTS

4. EXPERIMENTAL RESULTS

The results obtained during the course of investigation are presented in this chapter.

4.1 Growth studies

4.1.1 Germination

The data on germination (Table 4 and Appendix II) revealed that spring season planted crop gave significantly higher germination (49.8 and 47.7 per cent) than that of autumn sugarcane intercropped with mustard (41.0 and 40.4 per cent). Late spring sugarcane planted after wheat, however, exhibited minimum germination (35.3 and 29.8 per cent), being significantly lower than that of autumn and spring seasons planted crops during 1998-2000 and 1999-2000 crop season, respectively.

Genotypic variations with respect to germination were significant in 1998-2000. Genotype CoPant 93227 exhibited significantly more germination than that of CoPant 90223 and CoPant 92226. Variations in germination in CoPant 92226 and CoPant 90223 were significant where later exhibited more germination (39.3 and 45.5 per cent) than former (35.9 and 42.2 per cent) at 30 and 45 days after planting, respectively. Fertilizer levels did not affect cane germination at any of the stages during both the years.

Table 4: Germination (%) of sugarcane as influenced by cropping systems, genotypes and fertilizer levels

Treatment	Germination (%)			
	1998-2000		1999-2001	
	30 DAP	45 DAP	30 DAP	45 DAP
Cropping systems				
Autumn Sugarcane + Mustard (Divya)	36.2	41.0	36.0	40.4
Mustard (PR-15) - Spring Sugarcane	41.9	49.8	41.4	47.7
Wheat (UP-2338) - Late Spring Sugarcane	30.6	35.3	27.0	29.8
SEm±	0.4	0.5	1.7	1.9
CD at 5%	1.3	1.5	5.3	5.7
Genotypes				
Co Pant 90223	35.9	42.2	29.5	35.4
Co Pant 92226	39.3	45.5	32.4	36.3
Co Pant 93227	42.0	48.5	33.3	39.1
SEm±	0.4	0.5	1.7	1.8
CD at 5%	1.3	1.5	NS	NS
Fertilizer levels (% of recommended NPK)				
75	39.5	46.1	28.7	36.5
100	38.5	45.4	31.9	37.3
125	39.2	46.0	32.8	40.1
SEm±	0.6	0.6	1.4	1.4
CD at 5%	NS	NS	NS	NS

4.1.2 Number of shoot

The data (Table 5 and Appendix III & IV) revealed that the differences in number of shoots due to cropping systems, genotypes and fertilizer levels were significant at all the stages of crop growth during both the years (Fig. 2). The shoot population increased with crop age, maximum being in June in autumn season planted sugarcane. However, in spring and late spring season planted crops, maximum shoot population was recorded in July and August.

Autumn sugarcane intercropped with mustard produced significantly higher shoot population at all the stages of crop growth than that of spring and late spring season planted sugarcane. The differences in shoot population in late spring planted and spring season planted crops were also significant where former attained lower shoot population than later.

Among the genotypes, CoPant 93227 recorded significantly higher number of shoots than other genotypes at all the stages during both the years. In the month of August, maximum shoot population (139.9 and 135.8 thousand ha^{-1}) was recorded in CoPant 93227, being significantly higher than that of CoPant 92226 and CoPant 90223. Genotype CoPant 92226, however, produced minimum shoots of 116.0 and 111.3 thousand ha^{-1} during two crop seasons, respectively. The differences in CoPant 90223 and CoPant 92226 with respect to shoot population were also significant where former produced more shoot population than later.

Table 5; Shoot population (000 ha⁻¹) as influenced by cropping systems, genotypes and fertilizer levels

Treatment	Number of shoots (000 ha ⁻¹)											
	March		April		May		June		July		August	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems												
Autumn Sugarcane + Mustard (Divya)	-	-	95.9	93.1	121.5	149.0	133.1	155.0	127.1	136.7	122.6	128.2
Mustard (PR-15) - Spring Sugarcane	-	-	65.2	64.2	76.1	112.0	79.4	115.5	150.9	147.1	147.2	143.2
Wheat (UP -2338) - Late Spring Sugarcane	-	-	-	-	34.1	40.2	76.2	94.0	90.0	85.8	104.4	100.1
SEm±	-	-	1.6	4.1	1.9	1.4	1.5	1.2	2.1	2.8	2.6	3.1
CD at 5%	-	-	4.9	12.8	5.8	4.2	4.5	3.5	6.5	8.6	7.8	9.4
Genotypes												
Co Pant 90223	77.4	72.7	80.7	73.7	74.0	94.9	93.3	115.3	128.6	124.3	129.7	125.4
Co Pant 92226	72.9	71.8	75.1	73.6	69.2	91.2	85.0	114.3	115.6	110.5	116.0	111.3
Co Pant 93227	86.4	82.1	91.4	88.6	88.4	115.2	104.5	135.0	138.2	133.8	139.9	135.8
SEm±	1.9	1.6	2.0	4.9	1.9	1.4	1.5	1.2	2.1	2.8	2.6	3.1
CD at 5%	6.0	6.5	7.8	15.6	5.8	4.2	4.5	3.5	6.5	8.6	7.8	9.4
Fertilizer levels (% of recommended NPK)												
75	74.2	70.0	75.1	70.0	68.2	92.4	86.8	113.5	116.7	112.3	117.3	113.4
100	79.9	74.8	81.0	80.2	79.0	101.8	95.4	122.6	127.6	122.9	130.1	125.4
125	84.1	81.6	85.6	86.2	84.4	107.1	100.6	128.5	138.1	133.4	138.4	133.7
SEm±	2.6	3.2	1.7	2.1	1.9	1.4	1.7	1.5	3.2	4.5	2.7	3.2
CD at 5%	8.0	10.0	5.2	6.2	5.5	4.1	5.0	4.4	9.3	13.6	8.0	9.3

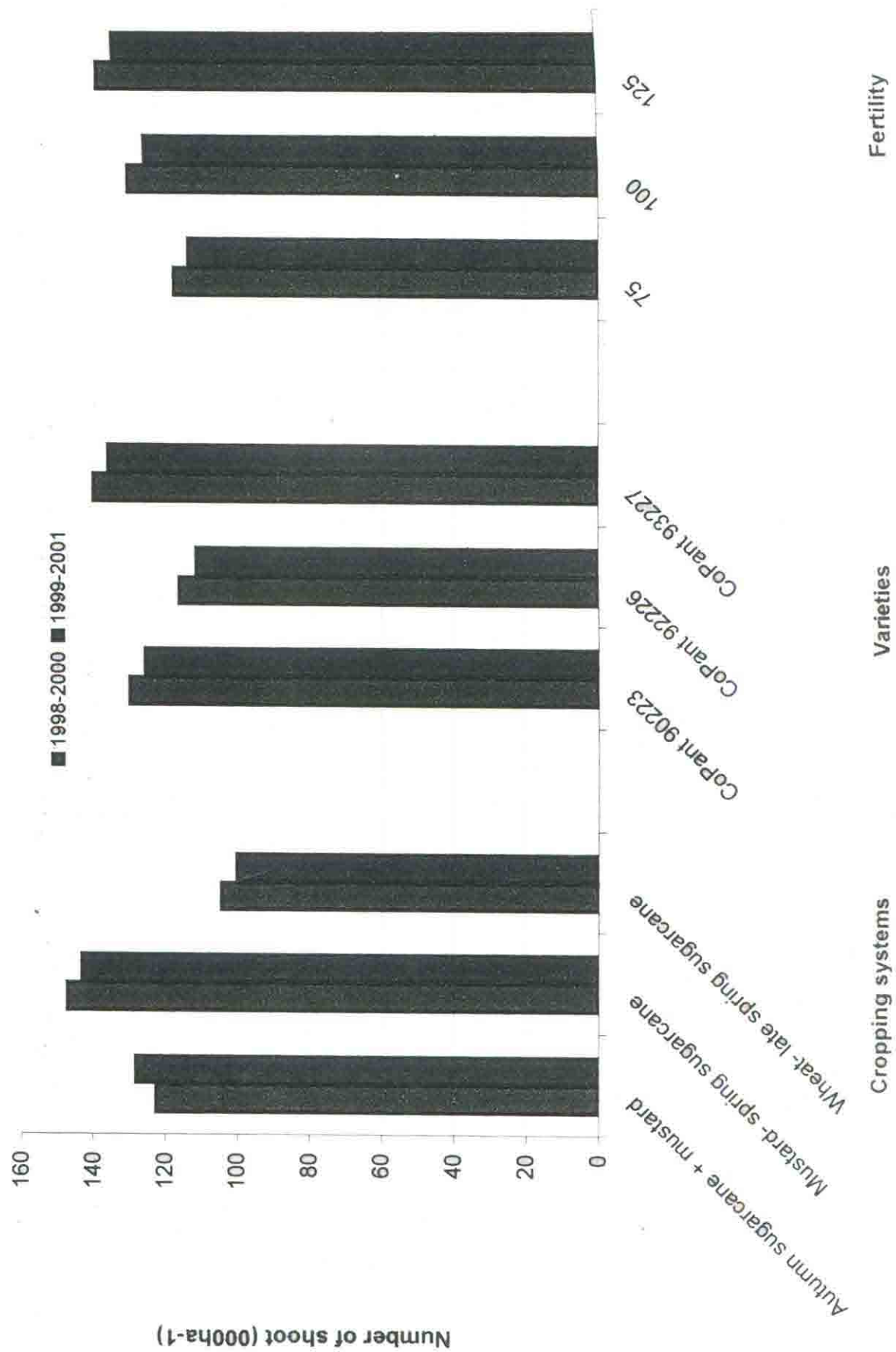


Fig.2: Effect of cropping systems, varieties and fertility level on shoot population

Table 5a: Interaction between cropping systems and genotypes for shoot population (000ha⁻¹)
in July

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	136.8	129.7	160.7	122.3	118.1	144.0
Mustard (PR-15) - Spring Sugarcane	155.4	123.3	174.3	144.8	117.5	167.2
Wheat (UP-2338) - Late Spring Sugarcane	103.7	79.7	86.7	110.2	94.0	96.0
	SEm±		CD at 5%	SEm ±		C D at 5%
For comparing two cropping systems/ genotypes	3.7		11.3	5.4		16.2

Table 5b: Interaction between cropping systems and genotypes for shoot population (000 ha⁻¹)
in August

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	128.2	122.6	148.4	122.3	118.1	144.0
Mustard (PR-15) - Spring Sugarcane	149.6	121.2	170.9	144.8	117.5	167.2
Wheat (UP-2338) - Late Spring Sugarcane	114.0	98.7	100.6	110.3	102.0	109.7
	SEm±		CD at 5%	SEm ±		C D at 5%
For comparing two cropping systems/ genotypes	4.5		13.5	5.4		16.2

Crop fertilized with 125 per cent of recommended NPK produced significantly higher number of shoots than that of 75 and 100 per cent recommended dose of NPK at all the stages of crop growth during both the years. During the month of August, crop receiving 125 per cent of the recommended NPK produced maximum shoot population (138.4 and 133.7 thousand ha^{-1}), being significantly higher than that of 75 and 100 per cent of fertilizer levels during both the years, respectively. Crop fertilized with 75 per cent recommended dose of NPK however, produced minimum shoots of 117.3 and 113.4 thousand ha^{-1} during two crop seasons, respectively.

The interaction between cropping systems and genotypes with respect to shoot population was significant in the month of July and August (Table 5 a&b) during both the crop seasons. The data (Table 5a) revealed that in July, under wheat-late spring sugarcane crop sequence, CoPant 90223 produced significantly higher shoot population than CoPant 92226 and CoPant 93227 during both the years. However, under autumn sugarcane + mustard and mustard-spring sugarcane crop sequences, CoPant 93227 produced significantly higher shoot population than CoPant 90223 and CoPant 92226. Similar trend was noted in August (Table 5b) during two crop seasons.

4.1.3 Shoot height

The data (Table 6 and Appendix V & VI) revealed that the differences in shoot height due to cropping systems, genotypes and fertilizer levels were

Table 6: Shoot height (cm) as influenced by cropping systems, genotypes and fertilizer levels during 1998-2000 and 1999-2001

Treatment	Shoot height (cm)											
	March			April			May			June		
	1998-2000	1999-2001	-	1998-2000	1999-2001	-	1998-2000	1999-2001	-	1998-2000	1999-2001	1998-2000
Cropping systems												August
Autumn Sugarcane + Mustard (Divya)	-	-	-	-	-	-	-	-	-	107.2	108.9	140.9
Mustard (PR-15) - Spring Sugarcane	-	-	-	-	-	-	-	-	-	95.9	97.4	117.4
Wheat (UP -2338) - Late Spring Sugarcane	-	-	-	-	-	-	-	-	-	-	-	95.2
SEm±	-	-	-	-	-	-	-	-	-	1.3	1.6	2.7
CD at 5%	-	-	-	-	-	-	-	-	-	4.4	5.1	8.1
Genotypes												
Co Pant 90223	55.3	58.4	67.1	69.9	77.1	78.2	87.2	88.2	101.6	104.8	142.3	145.1
Co Pant 92226	74.9	80.3	90.3	91.8	97.5	99.0	107.7	109.7	123.1	126.8	152.5	155.0
Co Pant 93227	83.0	83.8	92.9	94.1	99.8	101.4	109.8	111.4	126.2	129.2	154.9	157.4
SEm±	2.6	2.1	2.8	2.2	0.4	0.3	1.7	2.0	2.7	4.2	1.7	1.5
CD at 5%	9.9	8.2	11.2	8.4	1.5	1.3	5.4	6.3	8.1	12.9	5.3	4.6
Fertilizer levels (% of recommended NPK)												
75	66.5	69.2	76.8	79.2	85.4	87.2	93.9	95.4	103.3	106.6	134.9	137.5
100	71.6	75.7	83.6	86.3	92.0	93.5	102.4	104.6	117.4	121.0	150.8	153.2
125	75.3	77.7	89.9	90.3	96.9	97.9	108.3	109.3	130.1	133.2	164.1	167.6
SEm±	2.8	2.4	2.0	2.1	0.6	0.6	1.7	1.9	2.8	2.2	1.0	0.8
CD at 5%	NS	7.4	6.2	6.5	1.9	2.0	5.2	5.8	8.1	6.6	3.0	2.5

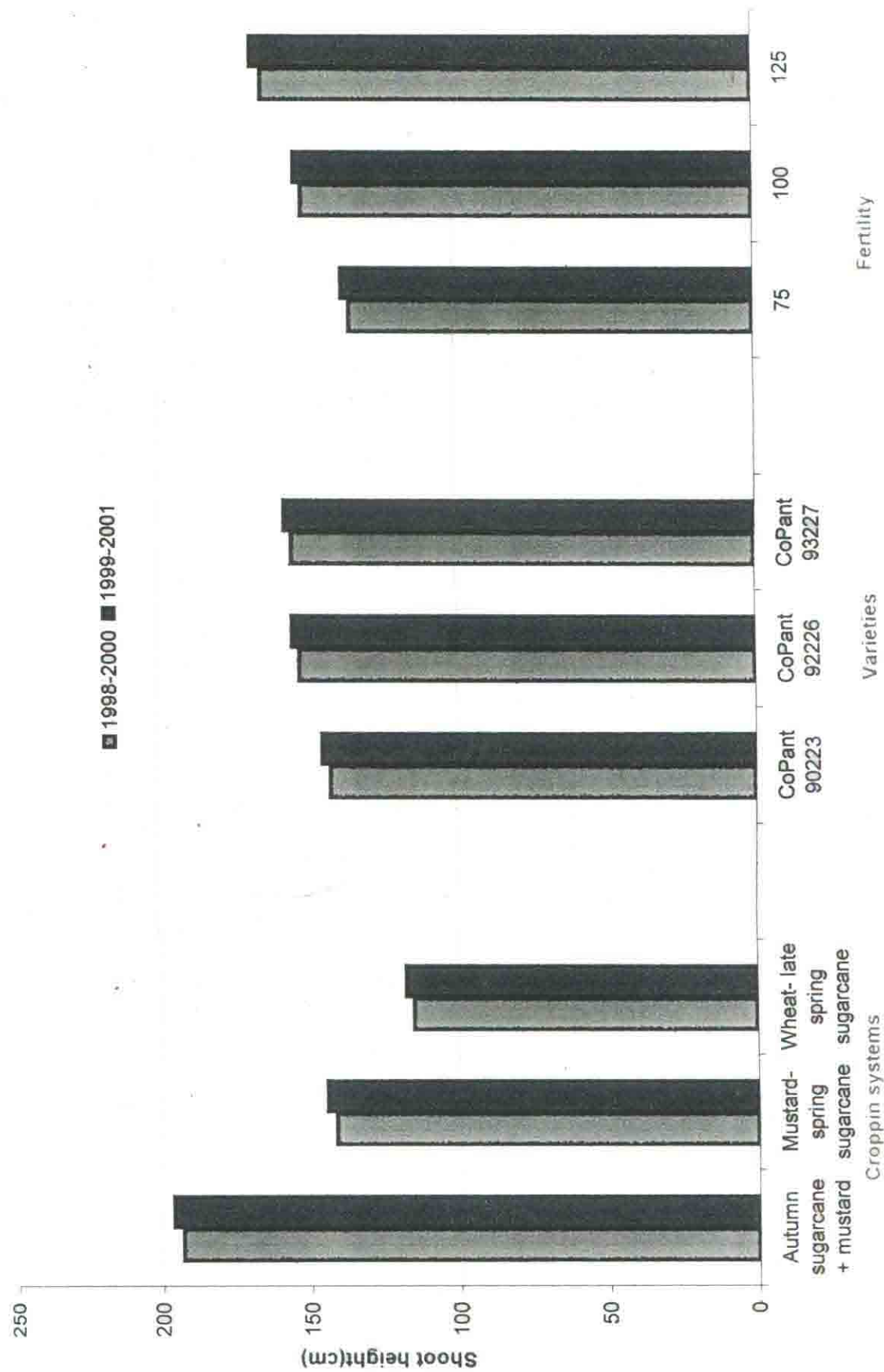


Fig.3: Effect of cropping systems ,varieties and fertility levelson shoot height in August

significant at all the stages of crop growth during 1998-2000 and 1999-2001. The shoot height increased with crop age, maximum being in August.

In August (Fig. 3), autumn sugarcane intercropped with mustard attained significantly higher shoot height (193.4 and 196.4 cm) than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during 1998-2000 and 1999-2001. The minimum shoot height of 115.1 and 117.6 cm was recorded in late spring sugarcane, being significantly lower than that spring sugarcane during two years, respectively.

Among genotypes, CoPant 93227 recorded significantly higher shoot height than that of other genotypes at all the crop growth stages. In August, maximum shoot height of 154.9 and 157.4 cm was recorded with CoPant 93227, being significantly higher than CoPant 92226 and CoPant 90223 during 1998-2000 and 1999-2001, respectively. Genotype CoPant 90223 attained minimum shoot height (142.3 and 145.1 cm) during both the years. The differences in shoot height between CoPant 90223 and CoPant 92226 were also significant where later exhibited more height (154.9 and 157.4 cm) than former during 1998-2000 and 1999-2001, respectively.

Increasing fertilizer levels from 75 to 125 per cent of the recommended NPK, improved shoot height at all the stages of crop growth. During the month of August, crop fertilized with 125 per cent of the recommended NPK attained maximum shoot height of 164.1 and 167.6 cm, being significantly higher than that of 75 and 100 per cent of recommended NPK during both the years. The

Table 6a: Interaction between cropping systems and genotypes for shoot height (cm) in the month of August

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	179.6	203.9	205.6	176.3	200.4	202.4
Mustard (PR-15) - Spring Sugarcane	141.3	144.7	147.1	138.6	141.4	144.2
Wheat (UP-2338) - Late Spring Sugarcane	114.5	117.3	121.0	112.1	114.8	118.3
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		2.6	7.9	3.0	9.2	

Table 6 b: Interaction between cropping systems and fertilizer levels for shoot height (cm) in the month of August

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	177.6	195.7	215.8	174.8	193.1	212.1
Mustard (PR-15) - Spring Sugarcane	140.1	147.1	150.0	131.7	144.7	148.9
Wheat (UP-2338) - Late Spring Sugarcane	116.9	119.7	123.8	110.2	114.6	119.5
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems at same and different levels of fertilizer		1.9	5.8	2.2	6.7	
For comparing two Fertilizer levels at same and different levels of cropping system		1.4	4.3	1.7	5.0	

differences in shoot height in 75 and 100 per cent of recommended NPK were also significant where later attained more shoot height (150.8 and 153.2 cm) than the former (134.9 and 137.5 cm) during both the years of crop seasons, respectively.

The interactions between cropping systems and genotypes noted in the month of August (Table 6a) revealed that genotypes CoPant 93227 and CoPant 92226, being at par, attained significantly higher shoot height than that of CoPant 90223 under autumn sugarcane + mustard intercrop sequences during both years. However, in mustard-spring sugarcane and wheat-late spring sugarcane crop sequence, differences in shoot height among genotypes were not significant during two crop seasons.

Interaction between cropping systems and fertilizer levels (Table 6b and Appendix V) for shoot height was also significant in August during both the years. The data revealed that during 1998-2000 under autumn sugarcane intercropped with mustard, crop fertilized with 125 per cent of recommended NPK attained significantly higher shoot height (215.8 cm) than that of 75 (177.6 cm) and 100 (195.7 cm) per cent of the recommended NPK. However, in spring sugarcane following mustard, differences in shoot height in 100 and 125 per cent of the recommended NPK were not significant but these treatments resulted in significantly more shoot height than that of 75 per cent of the recommended NPK. In late spring planted sugarcane crop, differences in shoot height in 75 and 100 per cent of the recommended NPK and 100 and 125 per cent of the

recommended NPK were not significant. Similar trend was noted during 1999-2001.

4.1.4 Dry matter accumulation per shoot

The data (Table 7 and Appendix VII & VIII) indicated that differences in dry matter accumulation per shoot due to different treatments were significant at all the crop growth stages during both the years except in June and July during 1998-2000 where varietal differences turned out to be non significant. Dry matter accumulation per shoot increased with crop age from June to August.

In August, autumn sugarcane intercropped with mustard accumulated significantly higher dry matter of 255.3 and 246.3 g/shoot than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during 1998-2000 and 1999-2001, respectively. The minimum dry matter of 127.9 and 121.1 g/shoot was accumulated in late spring sugarcane, being significantly lower than that of spring sugarcane during both the years, respectively.

Among the genotypes, CoPant 92226 accumulated significantly higher dry matter than that of CoPant 90223 and CoPant 93227 at all the stages during both the years except in June and July during 1998-2000. In August, maximum dry matter accumulation of 189.7 and 182.2 g/shoot was recorded with CoPant 92226, being significantly higher than that of CoPant 90223 and CoPant 93227 during 1998-2000 and 1999-2001, respectively. Genotype CoPant 93227, produced minimum dry matter of 182.2 and 174.5 g/shoot during both the years,

Table 7: Dry matter per shoot (g) at various stages, as influenced by cropping systems, genotypes and fertilizer levels during different months

Treatment		Dry matter per shoot (g)					
		1998-2000			1999-2001		
		June	July	August	June	July	August
Cropping systems							
Autumn Sugarcane + Mustard (Divya)		201.1	227.2	255.3	195.1	219.2	246.3
Mustard (PR-15) - Spring Sugarcane		82.8	127.3	174.2	77.6	121.3	166.2
Wheat (UP 2338) - Late Spring Sugarcane		-	80.1	127.9	-	75.1	121.1
SEm±		1.51	1.8	0.51	0.67	0.92	0.50
CD at 5%		4.76	5.6	1.55	2.13	2.76	1.52
Genotypes							
Co Pant 90223		141.8	144.7	185.6	136.3	138.3	177.9
Co Pant 92226		144.1	147.3	189.7	138.5	141.0	182.2
Co Pant 93227		139.8	142.7	182.2	134.1	136.3	174.5
SEm±		1.85	1.8	0.51	0.82	0.92	0.50
CD at 5%		NS	NS	1.55	2.61	2.76	1.52
Fertilizer levels (% of recommended NPK)							
75		138.7	141.9	181.2	133.0	135.6	173.3
100		141.8	144.8	185.3	136.3	138.4	177.6
125		145.3	148.0	191.1	140.0	141.7	183.4
SEm±		0.71	0.37	0.34	0.64	0.75	0.31
CD at 5%		2.07	1.07	1.00	1.87	2.15	0.89

respectively. The differences in dry matter accumulation in CoPant 90223 and CoPant 93227 were also significant where later exhibited lower dry matter than former during both the years.

Increasing fertilizer levels from 75 and 125 per cent of the recommended NPK, improved dry matter accumulation throughout the crop growth. During the month of August, crop fertilized with 125 per cent of the recommended doses of NPK attained maximum dry matter of 191.1 and 183.4 g/shoot, being significantly higher than that of 75 and 100 per cent of the recommended NPK during both the years, respectively. The differences in dry matter accumulation between 75 and 100 per cent of recommended NPK were also significant where later accumulated more dry matter (185.3 and 177.6 g/shoot) than the former (181.2 and 173.3 g/shoot) during two crop seasons, respectively. None of the interactions was significant at any of the crop growth stages.

4.1.5 Leaf area index

The data (Table 8a&b and Appendix IX & X) revealed that the differences in leaf area index due to different treatments were significantly at all the stages during both the crop seasons.

The leaf area index increased with crop age, maximum being during August-September and minimum March-April. Maximum leaf area attained (4.89 and 4.75) in autumn sugarcane + mustard, being significantly higher than that of spring and late spring sugarcane during both the years. The differences in leaf area index in (Fig. 4) autumn sugarcane intercropped with mustard and

Table 8a: Effect of cropping systems, genotypes and fertilizer levels on leaf area index (LAI) at different stages of crop growth

Treatment		Leaf area index					
		1998-2000					
		March - April	April - May	May - June	June - July	July - August	August - September
Cropping systems							
Autumn Sugarcane + Mustard (Divya)		-	2.00	2.54	2.93	3.73	4.89
Mustard (PR-15) - Spring Sugarcane		-	1.69	2.14	2.80	3.26	4.24
Wheat (UP 2338) - Late Spring Sugarcane		-	-	1.75	2.25	2.68	3.47
SEM±			0.006	0.005	0.005	0.008	0.009
CD at 5%			0.020	0.016	0.016	0.024	0.030
Genotypes							
Co Pant 90223		1.65	1.84	2.11	2.66	3.20	4.23
Co Pant 92226		1.71	1.94	2.31	2.74	3.36	4.32
Co Pant 93227		1.62	1.76	2.02	2.66	3.11	4.05
SEM±		0.007	0.008	0.005	0.005	0.008	0.009
CD at 5%		0.028	0.025	0.016	0.016	0.024	0.030
Fertilizer levels (% of recommended NPK)							
75		1.61	1.72	2.01	2.61	3.08	4.11
100		1.66	1.85	2.13	2.65	3.22	4.20
125		1.71	1.97	2.30	2.79	3.36	4.29
SEM±		0.013	0.009	0.007	0.007	0.006	0.007
CD at 5%		0.042	0.026	0.021	0.022	0.019	0.023

Table8b: Effect of cropping systems, genotypes and fertilizer levels on leaf area index (LAI) at different stages of crop growth

Treatment		Leaf area index						
		1999 - 2001						
		March - April	April - May	May - June	June - July	July - August	August - September	
Cropping systems								
Autumn Sugarcane + Mustard (Divya)		-	2.06	2.62	3.02	3.83	4.75	
Mustard (PR-15) - Spring Sugarcane		-	1.75	2.22	2.97	3.36	4.06	
Wheat (UP 2338) - Late Spring Sugarcane		-	-	1.83	2.33	2.79	3.39	
SEm±		-	0.006	0.006	0.005	0.008	0.008	
CD at 5%		-	0.021	0.018	0.016	0.024	0.024	
Genotypes								
Co Pant 90223		1.71	1.89	2.19	2.76	3.31	4.05	
Co Pant 92226		1.76	1.99	2.39	2.83	3.47	4.15	
Co Pant 93227		1.69	1.82	2.09	2.74	3.21	4.00	
SEm±		0.006	0.008	0.006	0.005	0.008	0.008	
CD at 5%		0.025	0.025	0.018	0.016	0.024	0.024	
Fertilizer levels (% of recommended NPK)								
75		1.68	1.78	2.09	2.70	3.19	3.96	
100		1.73	1.91	2.21	2.74	3.32	4.04	
125		1.77	2.03	2.37	2.88	3.47	4.20	
SEm±		0.014	0.009	0.007	0.007	0.006	0.006	
CD at 5%		0.043	0.026	0.021	0.021	0.019	0.018	

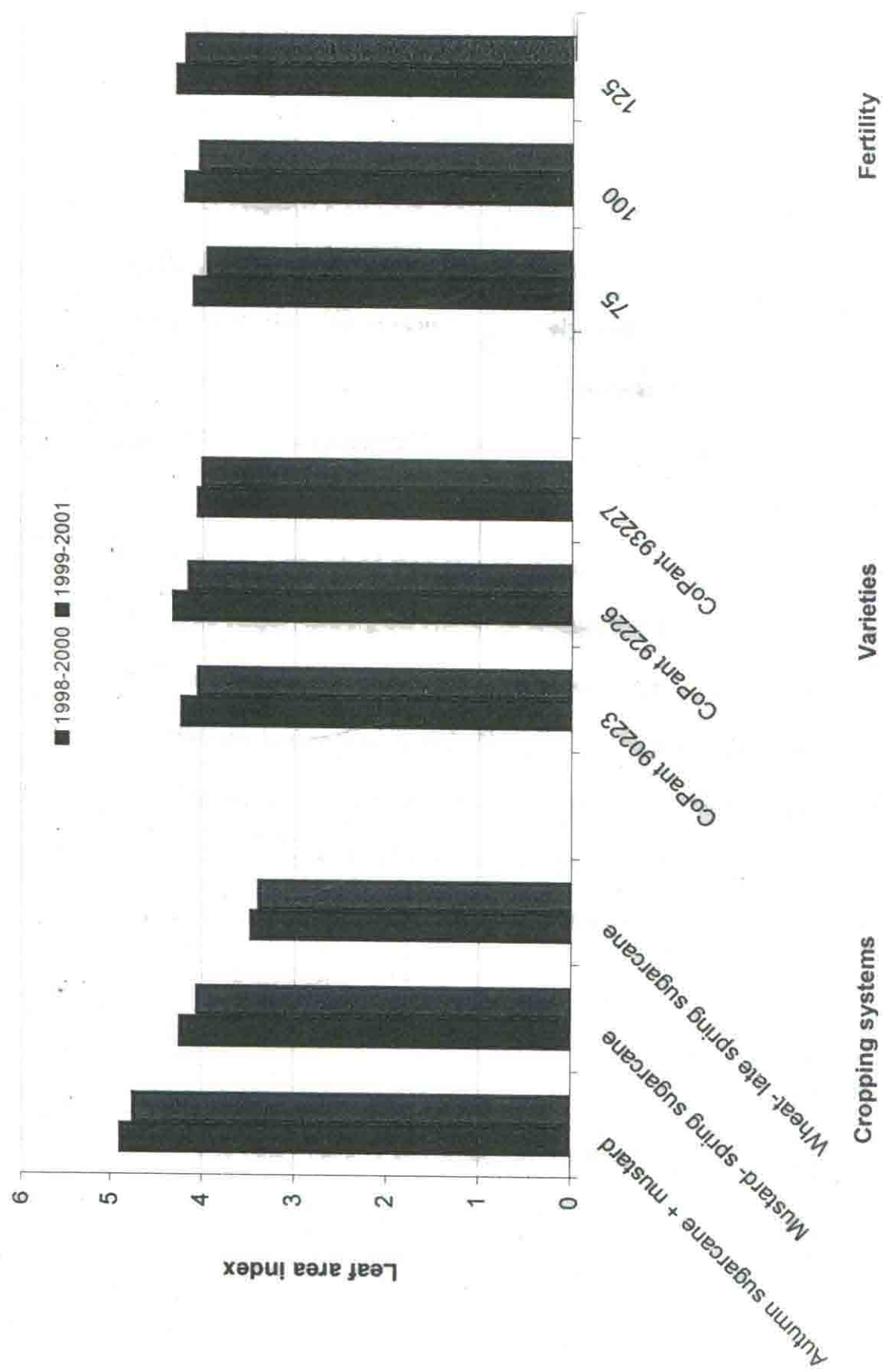


Fig.4: Effect of cropping systems, varieties and fertility levels on LAI

spring sugarcane planted after mustard were also significant, where former exhibited higher LAI than later during both the crop seasons.

Among the genotypes, CoPant 92226 revealed significantly higher LAI than CoPant 90223 and CoPant 93227 at all the stages of crop growth. In the month of August-September maximum LAI of 4.32 and 4.15 were recorded with CoPant 92226, being significantly higher than CoPant 90223 and CoPant 93227 during both the crop season, respectively. Genotype, CoPant 93227 exhibited minimum LAI of 4.05 and 4.00, being significantly lower than CoPant 92226. The difference between CoPant 90223 and 93227 was also significant.

Crop fertilized with 125 per cent of the recommended NPK produced significantly higher LAI than that of 75 and 100 per cent of recommended NPK at all the stages. During the month of August-September crop fertilized with 125 per cent of recommended NPK attained maximum LAI (4.29 and 4.20), being significantly higher than that of 100 (4.2 and 4.0) and 75 (4.1 and 3.9) per cent of fertilizer levels during both the years, respectively. Crop fertilized with 75 per cent of the recommended NPK levels attained minimum leaf area index (4.11 and 3.96), being significantly lower than 100 and 125 per cent of fertilizer levels during both the years.

4.1.6 Nutrients content

4.1.6.1 Nitrogen content in cane

The data (Table 9 and Appendix XI & XII) indicated that the differences in nitrogen content in cane due to cropping systems and fertilizer levels were significant at all the stages during both the years.

Table9: Nitrogen content in cane at various stages, under different treatments

Treatment		Nitrogen content (%)							
		1998-2000				1999-2001			
		June	July	August	June	July	August	June	August
Cropping systems									
Autumn Sugarcane + Mustard (Divya)		0.822	0.719	0.653	0.762	0.676	0.603		
Mustard (PR-15) - Spring Sugarcane		1.210	1.063	0.895	1.140	1.033	0.854		
Wheat (UP 2338) - Late Spring Sugarcane		-	1.162	0.994	-	1.132	0.954		
SEm±		0.008	0.005	0.015	0.022	0.013	0.015		
CD at 5%		0.026	0.016	0.045	0.072	0.04	0.047		
Genotypes									
Co Pant 90223		1.013	0.980	0.847	0.948	0.942	0.804		
Co Pant 92226		1.038	1.003	0.866	0.973	975	0.823		
Co Pant 93227		0.997	0.962	0.828	0.931	926	0.784		
SEm±		0.010	0.005	0.015	0.022	0.013	0.015		
CD at 5%		0.032	0.016	NS	NS	NS	NS		
Fertilizer levels (% of recommended NPK)									
75		0.995	0.958	0.822	0.930	0.918	0.779		
100		1.013	0.979	0.847	0.948	0.953	0.803		
125		1.040	1.008	0.873	0.975	0.971	0.830		
SEm±		0.007	0.004	0.006	0.007	0.005	0.006		
CD at 5%		0.022	0.013	0.018	0.022	0.015	0.019		

During August, autumn sugarcane intercropped with mustard contained significantly lower nitrogen of 0.653 and 0.603 per cent than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during 1998-2000 and 1999-2001, respectively. Late planted sugarcane crop contained maximum nitrogen of 0.994 and 0.954 per cent, being significantly higher than that of spring sugarcane during two crop seasons, respectively.

Genotypic variations in nitrogen content were not significant during both the years except in June and July during 1998-2000, where CoPant 92226 contained significantly higher nitrogen than CoPant 90223 and CoPant 93227.

Increasing fertilizer levels from 75 to 125 per cent of the recommended NPK increased nitrogen content in cane at all the stages of crop growth. During the month of August, crop fertilized with 125 per cent of recommended dose of NPK contained maximum nitrogen of 0.873 and 0.830 per cent, being significantly higher than that of 75 and 100 per cent of the recommended NPK during two years, respectively. The differences in nitrogen content between 75 and 100 per cent of the recommended NPK were also significant, where later contained more nitrogen (0.847 and 0.803 per cent) than the former (0.822 and 0.779 per cent) during both the years of crop seasons.

4.1.6.2 Phosphorus content in cane

The data (Table 10 and Appendix XIII & XIV) revealed that the differences in phosphorus content due to cropping system, genotypes and fertilizer levels were significant at all the stages during both the years except in

Table10: Phosphorus content in cane at various stages, under different treatments

Treatment	Phosphorus content (%)						
	1998-2000			1999-2001			
	June	July	August	June	July	August	August
Cropping systems							
Autumn Sugarcane + Mustard (Divya)	0.119	0.113	0.103	0.133	0.108		0.105
Mustard (PR-15) - Spring Sugarcane	0.151	0.138	0.108	0.153	0.134		0.108
Wheat (UP 2338) - Late Spring Sugarcane	-	0.158	0.128	-	0.146		0.124
SEm±	0.003	0.003	0.019	0.002	0.0007		0.0014
CD at 5%	0.010	0.009	NS	0.008	0.0022		0.0042
Genotypes							
Co Pant 90223	0.137	0.131	0.116	0.132	0.126		0.112
Co Pant 92226	0.138	0.142	0.144	0.140	0.138		0.119
Co Pant 93227	0.131	0.127	0.139	0.127	0.123		0.106
SEm±	0.004	0.003	0.019	0.0032	0.0007		0.0014
CD at 5%	NS	0.009	NS	0.010	0.0022		0.0042
Fertilizer levels (% of recommended NPK)							
75	0.123	0.126	0.110	0.127	0.122		0.106
100	0.138	0.133	0.148	0.133	0.129		0.112
125	0.145	0.141	0.121	0.140	0.136		0.120
SEm±	0.004	0.0006	0.018	0.0006	0.0003		0.0004
CD at 5%	0.013	0.0018	NS	0.0019	0.0009		0.0012

June and August during 1998-2000. Varietal differences in phosphorus content during 1998-2000 in August were not significant. The phosphorus content in cane decreased with crop age.

In August, late spring planted sugarcane contained significantly higher phosphorus (0.128 and 0.124 per cent) than that of spring sugarcane planted after mustard and autumn sugarcane intercropped with mustard during both the years. Differences in phosphorus content in autumn sugarcane and spring planted sugarcane were not significant.

Among genotypes, CoPant 92226 recorded significantly higher phosphorus than that of CoPant 90223 and CoPant 93227 at all the stages of crop growth except in June and August during 1998-2000. During 1999-2001 in August, maximum phosphorus content of 0.119 per cent was accumulated in CoPant 92226, being significantly higher than that of CoPant 90223 (0.112 per cent) and CoPant 93227 (0.106 per cent). The differences in phosphorus content in cane in CoPant 90223 and CoPant 93227 were also significant where later exhibited more phosphorus (0.106 per cent) than the former.

Fertilizer levels from 75 to 125 per cent of the recommended NPK, improved phosphorus content in cane at all the stages of crop growth. During the month of August in 1999-2001, crop fertilized with 125 per cent of the recommended dose of NPK contained maximum phosphorus content of 0.120 per cent, being significantly higher than that of 75 and 100 per cent of recommended NPK. The differences in phosphorus content in cane in 75 and 100

per cent of the recommended NPK were also significant where later contained more phosphorus (0.112 per cent) than the former (0.106 per cent). Similar trend was noted during 1998-2000 in June and July months.

4.1.6.3 Potassium content in cane

Variations in potassium content in cane (Table 11 and Appendix XV & XVI) due to different treatments were significant at all the stages during both the years. The potassium content in cane decreased with crop age.

In August, late spring planted sugarcane contained significantly higher potassium (1.474 and 1.456 per cent) than that of autumn sugarcane and spring planted sugarcane during both the years. The minimum potassium content of 1.179 and 1.185 per cent was recorded in autumn sugarcane, being significantly lower than that spring and late spring sugarcane during two crop years, respectively.

Genotypic variations with respect to potassium content revealed that CoPant 92226 contained significantly higher potassium in cane than CoPant 90223 and CoPant 93227 at all the crop growth stages. In the month of August, maximum potassium content of 1.389 and 1.366 per cent was recorded in CoPant 92226, being significantly higher than that of CoPant 90223 and CoPant 93227 during 1998-2000 and 1999-2001, respectively. Genotype, CoPant 93227 contained minimum potassium (1.147 and 1.159 per cent) during both the years. The differences in potassium content in cane in CoPant 90223 and CoPant 93227 were also significant where later recorded more potassium content (1.240 and

Table11: Potassium content in cane at various stages, under different treatments

Treatment		Potassium content (%)					
		1998-2000			1999-2001		
		June	July	August	June	July	August
Cropping systems							
Autumn Sugarcane + Mustard (Divya)		1.317	1.275	1.179	1.283	1.242	1.185
Mustard (PR-15) - Spring Sugarcane		1.587	1.396	1.322	1.562	1.372	1.302
Wheat (UP 2338) - Late Spring Sugarcane		-	1.487	1.474	-	1.459	1.456
SEm±		0.041	0.034	0.018	0.029	0.010	0.006
CD at 5%		0.130	0.105	0.056	0.091	0.031	0.018
Genotypes							
Co Pant 90223		1.425	1.366	1.240	1.395	1.337	1.217
Co Pant 92226		1.575	1.515	1.389	1.545	1.484	1.366
Co Pant 93227		1.355	1.277	1.147	1.327	1.253	1.159
SEm±		0.050	0.034	0.018	0.035	0.010	0.006
CD at 5%		0.159	0.105	0.056	0.113	0.031	0.018
Fertilizer levels (% of recommended NPK)							
75		1.347	1.286	1.131	1.317	1.256	1.141
100		1.439	1.362	1.258	1.409	1.339	1.237
125		1.569	1.509	1.386	1.541	1.478	1.364
SEm±		0.010	0.006	0.020	0.010	0.004	0.004
CD at 5%		0.031	0.018	0.058	0.030	0.012	0.012

1.217 per cent) than former (1.147 and 1.159 per cent) during 1998-2000 and 1999-2001, respectively.

Increasing fertilizer levels from 75 to 100 per cent of the recommended NPK, improved potassium content in cane at all the stages. During the month of August, crop fertilized with 125 per cent of the recommended doses of NPK contained maximum potassium of 1.386 and 1.364 per cent, being significantly higher than that of 75 and 100 of recommended NPK during both the years, respectively. The differences in potassium content between 75 and 100 per cent of NPK levels were also significant where later attained more potassium (1.258 and 1.237 per cent) than former (1.131 and 1.141 per cent) during both the years of crop seasons, respectively.

Interaction between cropping systems, and fertilizer levels (Table 11a and Appendix XVI) for potassium content was also significant in July during both the years and in August during 1999-2001. The data revealed that during both the years under autumn sugarcane + mustard intercropping, crop fertilized with 125 per cent of the recommended NPK contained significantly lower potassium content (1.572 and 1.600 per cent) than that of 75 (1.353 and 1.401 per cent) and 100 (1.454 and 1.529 per cent) per cent of the recommended NPK. However, in spring sugarcane following mustard crop sequence, differences in potassium content between 75 and 125 per cent of NPK were also significant during both the years. In late spring planted sugarcane crop, differences in potassium content between 75 and 100 and 100 and 125 per cent of the recommended NPK were also significant during both the years.

The interactions between genotypes and fertilizer levels (Table 11b and Appendix XV & XVI) for potassium content were though significant but did not follow definite trend.

4.2 Studies at harvest

4.2.1 Cane length

The data on cane length (Table 12 and Appendix XVI & XVIII) revealed that autumn sugarcane intercropped with mustard attained significantly higher cane length (259.8 and 269.7 cm) than that of spring planted sugarcane after mustard and late spring planted sugarcane after wheat. The differences (Fig. 5) in cane length in spring and late spring season planted crops were significant during 1999-2001 where later attained less cane length (186.2 cm) than former (246.0 cm).

Among genotypes, CoPant 93227 exhibited significantly more cane length (253.0 and 242.9 cm) than that of CoPant 90223 (242.7 and 221.1 cm) during 1998-2000 and 1999-2001, respectively. However, differences in cane length between CoPant 92226 and CoPant 93227 were not significant during both the years.

Fertilizer levels brought significant variations in cane length. Crop fertilized with 125 per cent of recommended NPK, being at par with that of 100 per cent of the recommended NPK produced significantly higher cane length than that of 75 of recommended dose of NPK during 1998-2000 and 1999-2001. The differences in cane length at 75 and 100 per cent of the recommended NPK were not significant during both the years.

Table 12: Cane length, cane weight, internodes per cane and cane girth as influenced by cropping systems, genotypes and fertilizer levels during 1998-2000 and 1999-2001

Treatment	Cane length (cm)		Cane weight (g)		Internodes per cane		Cane girth (cm)	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems								
Autumn Sugarcane + Mustard (Divya)	259.8	269.7	828	821	25	24	6.8	7.0
Mustard (PR-15) - Spring Sugarcane	244.8	246.3	798	764	22	22	6.4	6.8
Wheat (UP-2338) - Late Spring Sugarcane	236.0	186.2	740	678	21	18	6.0	6.5
SEm±	3.4	1.5	11.7	6.5	0.3	0.3	0.07	0.08
CD at 5%	10.3	4.7	35.1	19.7	1.0	0.9	0.23	0.25
Genotypes								
Co Pant 90223	242.7	221.1	777	749	21	20	6.6	6.8
Co Pant 92226	244.8	238.2	842	843	23	22	6.7	6.8
Co Pant 93227	253.0	242.9	761	658	24	22	6.0	6.5
SEm±	3.4	1.5	11.7	6.5	0.3	0.3	0.07	0.08
CD at 5%	10.3	4.7	35.1	19.7	1.0	0.9	0.23	0.25
Fertilizer levels (% of recommended NPK)								
75	239.6	232.0	742	723	22	21	6.0	6.6
100	246.5	233.1	782	744	23	21	6.5	6.8
125	255.0	238.4	853	782	24	22	7.0	7.0
SEm±	3.4	1.9	8.5	3.8	0.3	0.3	0.11	0.11
CD at 5%	9.5	5.6	24.5	11.0	0.9	0.9	0.34	NS

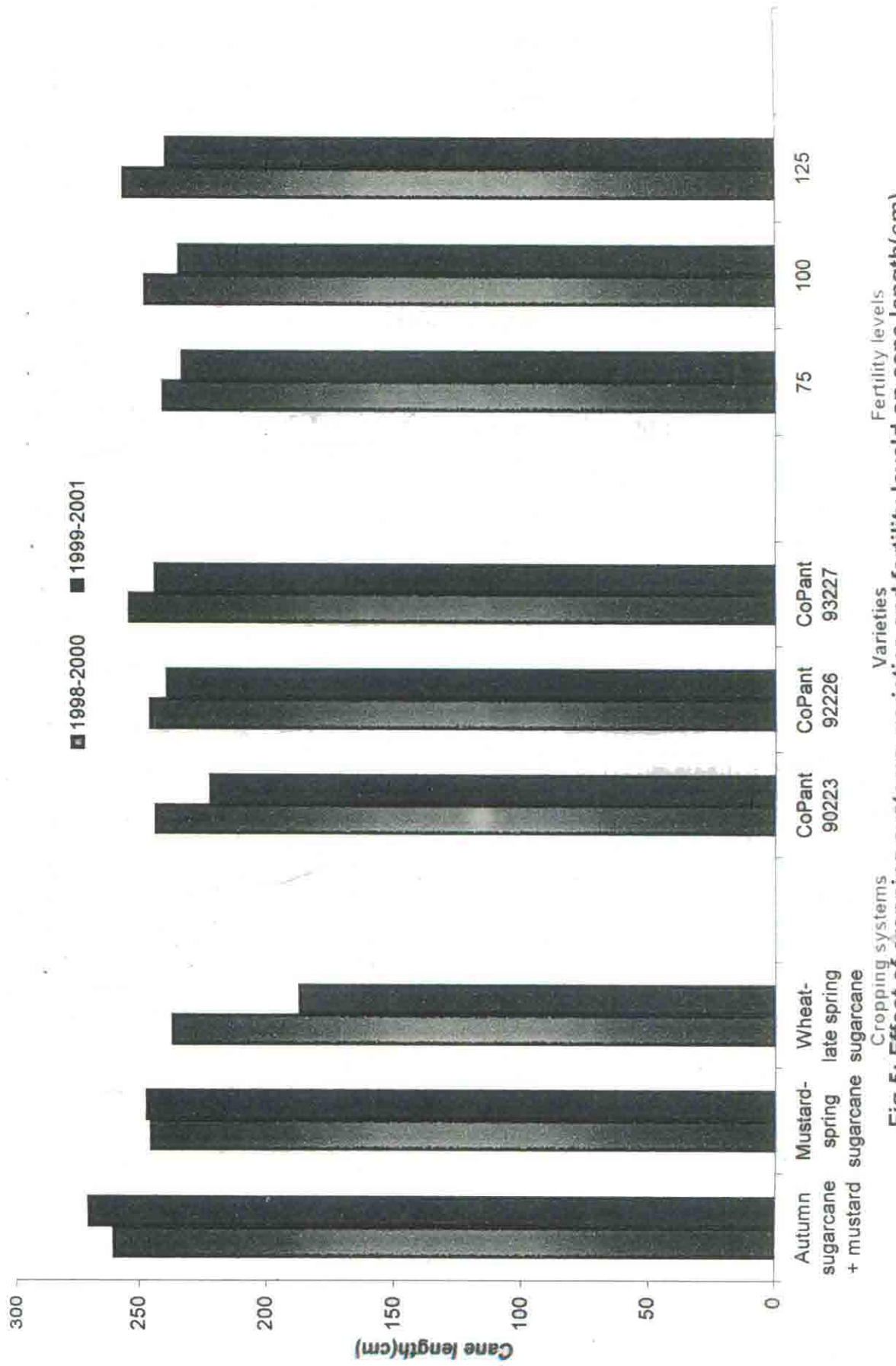


Fig.5: Effect of cropping systems , varieties and fertility level on cane length(cm)

Table 12a: Interaction effect of cropping systems and Genotypes on cane length (cm)

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn sugarcane + Mustard (Divya)	246.8	265.1	267.3	245.8	276.4	286.8
Mustard (PR-15) – Spring sugarcane	242.7	238.6	253.2	244.0	240.7	254.3
Wheat (UP- 2338) – Late spring sugarcane	238.6	230.5	240.0	187.6	177.5	193.4
		SEm ±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ Genotypes		6.7	20.1	2.7	8.1	

Table 12b: Interaction between cropping systems and fertilizer levels for cane length (cm)

Genotypes	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
CoPant 90223	237.7	244.9	256.2	228.9	241.5	243.6
CoPant 92226	242.6	256.9	261.8	241.7	243.4	244.0
CoPant 93227	236.1	240.3	247.2	211.7	221.5	230.1
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two genotypes at same/ different levels of fertilizer levels		3.5	10.4	3.1	9.3	
For comparing two fertilizer levels at same levels of genotypes		3.2	9.4	3.30	9.5	

The interactions between cropping system and genotypes and cropping systems and fertilizer levels for cane length (Table 12 a & b) were however, significant but did not follow definite trend.

Interactions between genotypes and fertilizer levels (Table 12b) indicated that during 1998-2000, under 75 per cent of the recommended NPK, all genotypes attained statistically same cane length. However, under 100 and 125 per cent recommended NPK, CoPant 92226 attained significantly more cane length than CoPant 93227. During 1999-2001, almost similar trend was noted except that differences in cane length in CoPant 92226 and CoPant 93227 under 75 per cent of recommended NPK were also significant.

4.2.2 Cane weight

The data on individual cane weight (Table 12 and Appendix XVII & XVIII) revealed that autumn planted sugarcane intercropped with mustard produced crop of significantly higher cane weight (828 and 821 g, respectively) than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during both the seasons. The differences in individual cane weight under spring and late spring planted sugarcane were also significant where later exhibited lower cane weight (740 and 678 g) than former (778 and 764 g) during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to individual cane weight were also significant during both the years. Genotype CoPant 92226 exhibited heaviest cane of 842 and 843 g followed by CoPant 90223 (777 and 749 g) and CoPant 93227 (761 and 658 g) during 1998-2000 and 1999-2001, respectively.

Table 12c: Interaction between cropping systems and genotypes for weight per cane (g)

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	814.0	891.0	781.0	801.1	914.0	717.0
Mustard (PR-15) - Spring Sugarcane	771.0	839.0	783.0	753.0	860.0	671.0
Wheat (UP-2338) - Late Spring Sugarcane	744.0	794.0	719.0	692.0	755.0	586.0
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		20.3	60.8	11.4	34.1	

Table 12d: Interaction between cropping systems and fertilizer levels for weight per cane (g) during 1998-2000 and 1999-2001

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	767.0	819.0	899.0	778.0	793.0	867.0
Mustard (PR-15) - Spring Sugarcane	744.0	783.0	865.0	736.0	761.0	786.0
Wheat (UP-2338) - Late Spring Sugarcane	717.0	744.0	797.0	656.0	678.0	699.0
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems at same/ different levels of fertilizer		9.2	27.8	8.5	25.4	
For comparing two fertilizer levels at same/ different levels of cropping systems		9.6	28.4	6.6	19.0	

Crop fertilized with 125 per cent of recommended dose of NPK attained significantly higher cane weight than that of 75 and 100 per cent of recommended NPK levels during both the years. The variations in average cane weight under 75 and 100 per cent recommended dose of NPK levels were also significant where later exhibited more individual cane weight (782 and 744 g) than former (742 and 723 g) during 1998-2000 and 1999-2001, respectively.

Interactions between cropping systems and genotypes with respect to individual cane weight were significant during both the years (Appendix XVII). The data (Table 12c) revealed that during 1998-2000 under autumn planted sugarcane + mustard crop sequence, CoPant 92226 recorded significantly higher cane weight (891 and 914 g) than that of CoPant 90223 and CoPant 93227. However, under mustard-spring crop sequence, differences in cane weight between CoPant 90223 and CoPant 92226 were not significant. In wheat-late spring sugarcane crop sequences, differences in cane weight in CoPant 92226 and CoPant 93227 were not significant. The interactions between cropping systems and genotypes during 1999-2001, was significant but did not follow any definite trend.

Interaction between cropping system and fertilizer (NPK) levels (Table 12d) exhibited that during 1998-2000, in autumn sugarcane + mustard sequence, crop receiving 125 per cent of recommended NPK levels produced cane of significantly higher weight (899 g) than that of 75 per cent (767 g) and 100 per cent recommended NPK (819 g). However, in mustard spring sugarcane and

wheat-late spring sugarcane crop sequences, differences in cane weight under 100 and 125 per cent of the recommended NPK were not significant. Interactions between cropping system and fertilizer (NPK) levels during 1999-2001 was though significant but did not follow definite trend. The interaction between cropping systems and genotypes for individual cane weight was not significant.

4.2.3 Number of internodes per cane

The data on number of internodes per cane (Table 12 and Appendix XVII & XVIII) revealed that autumn cane inter cropped with mustard exhibited higher number of internodes per cane (25 and 24, respectively) than that of spring sugarcane and later spring sugarcane during both the crop seasons. Late spring sugarcane planted after wheat exhibited minimum number of internodes (21 and 18, respectively), being significantly lower than that of autumn sugarcane and spring sugarcane during both the years.

Among the genotypes, CoPant 93227 exhibited significantly more number of internodes than that of CoPant 92226 and CoPant 90223 during 1998-2000. However, in 1999-2001, differences in number of internodes in CoPant 93227 and CoPant 92226 were not significant. Variations in number of internodes per cane in CoPant 90223 and CoPant 92226 were significant where former exhibited less number of internodes (21 and 20) than later (23 and 22) during both the years, respectively.

Increasing fertilizer (NPK) levels from 75 to 125 per cent of the recommended NPK improved number of internodes per cane during 1998-2000.

However during 1999-2001 differences in internodes per cane under 75 and 100 per cent of the recommended NPK were not significant but crop receiving 125 per cent of the recommended NPK attained more number of internodes per cane than that of 75 and 100 per cent of the recommended NPK.

Interaction between cropping systems and genotypes with respect to number of internodes per cane was though significant (Appendix XVII & XVIII) but did not follow definite trend.

4.2.4 Cane girth

Data summarized in Table 12 and Appendix XVII & XVIII revealed that variations in cane girth due to different treatments were significant. Autumn planted cane with mustard inter crop, exhibited significantly higher cane girth (6.8 and 7.0 cm) than that of spring sugarcane following mustard and late spring sugarcane following wheat crop. The variations in cane girth in late spring and spring planted crops were also significantly where former exhibited lower cane girth (6.0 and 6.5 cm) than later (6.4 and 6.8 cm) during 1998-2000 and 1999-2001, respectively.

Genotypes, CoPant 90223 and CoPant 92226, being at par exhibited significantly more cane girth than CoPant 93227 during both the years. Variations in cane girth due to fertilizer levels were significant during 1998-2000, where crop receiving 125 per cent of recommended NPK exhibited significantly higher cane girth than that of 75 and 100 per cent recommended NPK. Crop fertilized with 75 per cent recommended NPK, however produced

canes of significantly less girth (6.0 cm) than that of 100 and 125 per cent of recommended NPK.

4.2.5 Number of millable canes

The data on number of millable canes (Table 13 and Appendix XVII & XVIII) revealed that significantly higher number of millable canes (120.0 and 96.0 thousand ha^{-1}) was recorded under autumn sugarcane intercropped with mustard (divya) than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop. Late spring sugarcane planted after wheat exhibited minimum number of millable canes (76.1 and 75.9 thousand ha^{-1}), being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to number of millable canes were significant during both the crop seasons. Genotype, CoPant 93227 exhibited significantly more number of millable canes (103.0 and 96.4 thousand ha^{-1} , respectively) than that of CoPant 90223 and CoPant 92226 during both the crop seasons. Variations in millable canes number in CoPant 90223 and CoPant 92226 with respect to number of millable canes were not significant during both the years.

Millable cane number (Fig. 6) varied significantly due to fertilizer (NPK) levels during both the crop seasons. Crop fertilized with 125 per cent of recommended NPK produced maximum number of millable canes of 105.7 and 94.6 thousand ha^{-1} , being significantly higher than that of 75 per cent of

Table 13: Number of millable cane (000 ha⁻¹), cane, green top, trash and biological yield (t ha⁻¹) as influenced by cropping systems, genotypes and fertilizer levels

Treatment	NMC		Cane yield		Green top yield		Trash yield		Biological yield	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems										
Autumn Sugarcane + Mustard (Divya)	120.0	96.0	99.0	80.0	13.9	11.2	12.0	9.5	124.9	100.7
Mustard (PR-15) - Spring Sugarcane	98.6	91.4	78.0	70.3	10.2	9.7	9.5	8.6	97.7	88.6
Wheat (UP- 2338) - Late Spring Sugarcane	76.1	75.9	55.2	51.9	6.7	7.3	6.1	6.2	67.8	65.4
SEm±	1.3	0.7	1.2	1.1	0.3	0.3	0.2	0.2	1.2	0.9
CD at 5%	3.9	2.2	3.6	3.3	0.9	0.9	0.6	0.7	3.6	2.9
Genotypes										
Co Pant 90223	94.7	91.7	77.0	69.2	9.9	8.9	9.1	7.8	97.4	86.0
Co Pant 92226	93.0	89.8	74.0	62.5	10.2	9.2	8.9	7.7	93.0	80.1
Co Pant 93227	103.0	96.4	79.2	70.1	10.0	9.0	9.9	8.5	98.8	86.7
SEm±	1.3	0.7	1.2	1.1	0.3	0.3	0.2	0.2	1.2	0.9
CD at 5%	3.9	2.2	3.6	3.3	NS	NS	0.6	0.7	3.6	2.9
Fertilizer levels (% of recommended NPK)										
75	83.9	80.1	62.7	59.1	8.1	7.9	7.5	6.6	78.4	73.5
100	101.0	91.7	78.8	67.8	10.7	9.3	9.7	8.2	99.7	85.2
125	105.7	94.6	90.0	75.7	11.9	10.9	10.5	9.5	112.5	96.2
SEm±	2.9	0.9	0.9	0.7	0.4	0.2	0.3	0.3	1.1	0.7
CD at 5%	8.5	3.0	2.7	2.2	1.3	0.8	1.0	0.9	3.3	2.2

Table 13a: Interaction between cropping systems and genotypes for number of millable canes (000 ha⁻¹) at harvest

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	116.0	115.0	128.4	97.7	90.0	105.0
Mustard (PR-15) - Spring Sugarcane	97.5	94.0	104.3	93.8	80.8	101.2
Wheat (UP-2338) - Late Spring Sugarcane	70.0	68.6	76.9	73.5	69.4	84.7
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		2.2	6.8	1.2	3.6	

Table 13b: Interaction between cropping systems and fertilizer levels for number of millable canes (000 ha⁻¹) at harvest

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	102.5	124.7	132.9	88.0	99.0	103.1
Mustard (PR-15) -Spring Sugarcane	86.7	102.4	106.8	85.9	91.9	95.0
Wheat (UP-2338) - Late Spring Sugarcane	62.8	75.9	77.3	66.5	80.0	83.3
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems at same/different levels of fertilizer		2.3	7.5	1.2	3.6	
For comparing two fertilizer levels at same/different levels of cropping systems		2.2	6.7	1.2	3.4	

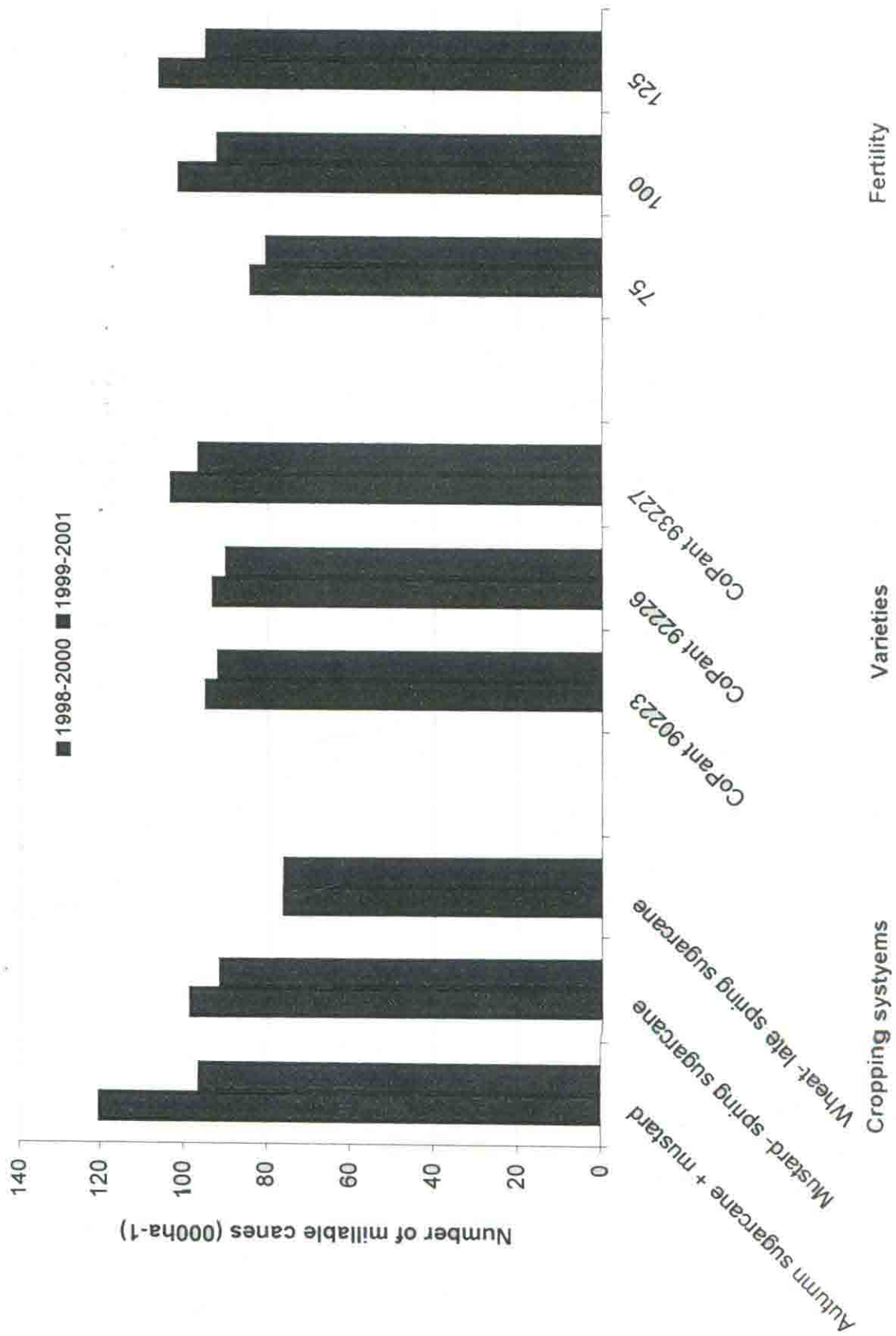


Fig.6: Effect of cropping system , varieties and fertility on number of millable canes(00ha⁻¹)

recommended NPK during 1998-2000 and 1999-2001, respectively. The differences in cane number under 100 and 125 per cent of the recommended NPK were not significant during both the years. However, millable cane number under 75 and 100 per cent of the recommended NPK varied significantly where former exhibited lower cane number (83.9 and 80.1 thousand ha^{-1}) than later (101.0 and 91.7 thousand ha^{-1}), during 1998-2000 and 1999-2001, respectively.

The interactions between cropping systems and genotypes, and cropping systems and fertilizer levels with respect to number of millable canes were significant (Appendix XVII & XVIII) during both the years. The data (Table 13a) revealed that during 1998-2000, under autumn sugarcane intercropped with mustard and mustard-spring sugarcane crop sequences, CoPant 93227 recorded significantly higher number of millable canes, being significantly higher than that of CoPant 90223 and CoPant 92226. However, under wheat late spring sugarcane crop sequence, differences in cane number in CoPant 93227 and CoPant 90223 were not significant. Similar trend was noted in 1999-2001 except that differences in cane number between CoPant 90223 and CoPant 92226 were also turned to be significant.

Significant interactions between cropping systems and fertilizer levels with respect to number of millable canes (Table 13b) revealed that during 1998-2000, under autumn sugarcane intercropped with mustard, crop fertilized with 125 per cent of recommended NPK produced significantly higher number of millable canes (132.9 thousand ha^{-1}) than that of 75 and 100 per cent (102.5 and

124.7 thousand ha^{-1}) of the recommended NPK. However, under mustard-spring sugarcane and wheat-late spring sugarcane crop sequences, differences in cane number between 100 and 125 per cent of the recommended NPK were not significant. During 1999-2001, similar trend was observed except that differences in cane number in 100 and 125 per cent of the recommended NPK under mustard-spring sugarcane were also significant.

4.2.6 Cane yield

Variations in cane yield due to cropping systems, genotypes and fertilizer levels were significant (Appendix XIX & XX). Data (Table 13 & Fig. 7) indicated that autumn season planted sugarcane intercropped with mustard (divya) produced significantly higher cane yield (99.0 and 80.0 t ha^{-1}) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat (UP 2338) crop during both the years. Late spring planted sugarcane gave minimum cane yield of 55.2 and 51.9 t ha^{-1} , being significantly lower than that of 78.0 and 70.3 t ha^{-1} under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to cane yield were significant during both the years. CoPant 93227 exhibited significantly higher cane yield (79.2 and 70.1 t ha^{-1}) than that of CoPant 92226 during 1998-2000 and 1999-2001, respectively. Differences in cane yield in CoPant 90223 and CoPant 92226 were also significant during 1998-2000. However, during 1999-2001, CoPant 90223 produced significantly higher cane yield (69.2 t ha^{-1}) than that of CoPant 92226 (62.5 t ha^{-1}).

Table 13c: Interaction between cropping systems and genotypes for cane yield ($t\ ha^{-1}$)

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	94.6	98.0	103.8	74.5	81.2	86.0
Mustard (PR-15) - Spring Sugarcane	79.7	75.4	79.0	71.5	68.8	70.7
Wheat (UP-2338) - Late Spring Sugarcane	55.7	53.6	54.8	58.6	44.6	52.4
		SEm $\pm$	CD at 5%	SEm $\pm$	C D at 5%	
For comparing two cropping systems/ genotypes		2.0	6.1	1.9	5.7	

Table 13d: Interaction between cropping systems and fertilizer levels for cane yield ($t\ ha^{-1}$)

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	78.0	100.4	118.0	69.8	81.4	90.0
Mustard (PR-15) - Spring Sugarcane	64.4	79.3	90.1	62.7	69.3	78.9
Wheat (UP-2338) - Late Spring Sugarcane	45.7	56.7	61.2	44.7	52.6	58.4
		SEm $\pm$	CD at 5%	SEm $\pm$	C D at 5%	
For comparing two cropping systems at same/ different levels of fertilizer		1.7	5.2	1.5	4.6	
For comparing two fertilizer levels at same/different levels of cropping systems		1.5	4.6	1.3	3.9	

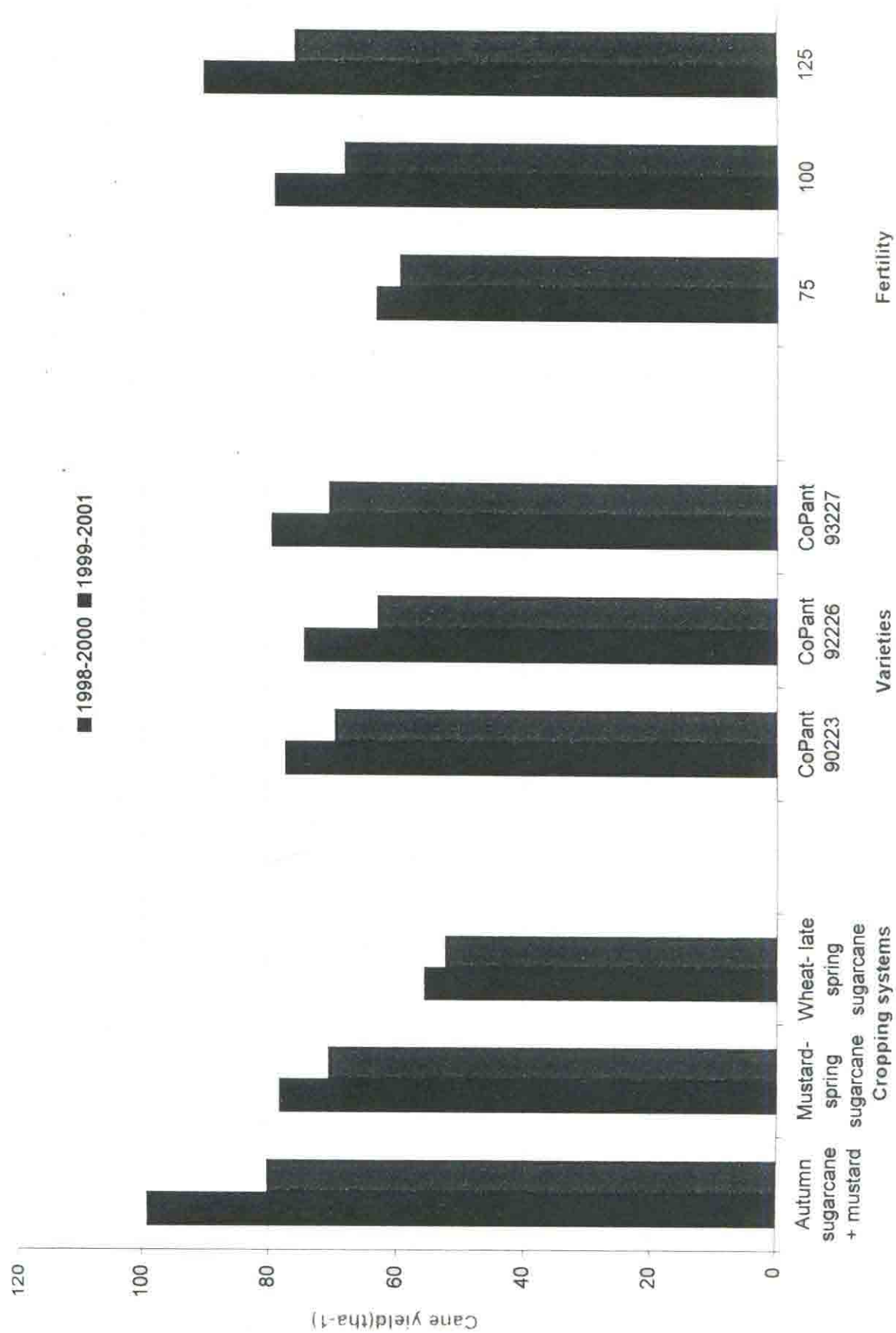


Fig.7: Effect of cropping systems, varieties and fertility levels on cane yield (tha-1)

Crop fertilized with 125 per cent of the recommended NPK produced significantly higher cane yield (90.0 and 75.7 t ha⁻¹) than that of 75 and 100 per cent of the recommended NPK during both the years. Differences in cane yield between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower cane yield (62.7 and 59.1 t ha⁻¹) than later (78.8 and 67.8 t ha⁻¹) during both the years, respectively.

Interactions between cropping systems, genotypes and fertilizer levels with respect to cane yield were significant during both the years (Appendix XIX & XX). Data (Table 13c) revealed that during 1998-2000, under autumn sugarcane + mustard crop sequence, CoPant 93227 recorded significantly higher cane yield (103.8 t ha⁻¹) than CoPant 90223. However, in mustard-spring sugarcane and wheat later spring sugarcane crop sequences, differences in cane yield among CoPant 90223, CoPant 93227 and CoPant 92226 were not significant. During 1999-2001, almost similar trend was noted except that differences in cane yield in CoPant 93227 and CoPant 92226 under autumn sugarcane + mustard and wheat-late spring sugarcane crop sequences were significant.

Interaction between cropping systems and fertilizer levels (Table 13d) revealed that during 1998-2000, increasing fertilizer levels from 75 to 125 per cent of the recommended NPK significantly improved the cane yield under autumn sugarcane + mustard intercrop and mustard-spring sugarcane crop sequences. However, under wheat-late spring sugarcane differences in cane yield

under 100 and 125 per cent of the recommended NPK were not significant. During 1999-2001 though interaction was significant but did not follow definite trend.

Genotypes and fertilizer levels interaction (Table 13e) revealed that during 1998-2000, all genotypes yielded at par under 75 per cent of the recommended of NPK. However, under 100 and 125 per cent of the recommended NPK, CoPant 92226 (81.1 t ha^{-1}), being at par with CoPant 90223 (80.2 t ha^{-1}) yielded significantly higher than that of CoPant 93227 (75.0 t ha^{-1}). During 1999-2001, almost similar trend was noted except that differences in cane yield in CoPant 90223 and CoPant 93227 under 125 per cent of the recommended NPK were also significant.

4.2.6.1 Green top yield

Variations in green top yield due to cropping systems, genotypes and fertilizer levels were significant (Appendix XIX & XX). Data (Table 13) indicated that autumn season planted sugarcane intercropped with mustard produced significantly higher green top yield (13.9 and 11.2 t ha^{-1}) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years. Late spring sugarcane gave minimum cane yield of 6.7 and 7.3 t ha^{-1} , being significantly lower than that of 10.2 and 9.7 t ha^{-1} under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to green top yield were however, not significant during both the years. Crop fertilized with 125 per cent of

the recommended NPK produced significantly higher green top yield (11.9 and 10.9 t ha⁻¹) than that of 75 and 100 per cent of the recommended NPK during both the years except that during 1998-2000 differences in green top yield at 100 and 125 per cent of the recommended NPK were not significant. The differences in green top yield between 75 and 100 per cent of the recommended NPK levels were significant where former exhibited lower green top yield (8.1 and 7.9 t ha⁻¹) than later (10.7 and 9.3 t ha⁻¹) during two years, respectively.

4.2.6.2 Trash yield

Data on trash yield (Table 13 and Appendix XIX & XX) exhibited that significantly higher trash yield of 12.0 and 9.5 t ha⁻¹ was obtained from autumn season sugarcane intercropped with mustard than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop sequences during two years, respectively. Late spring sugarcane planted after wheat harvesting gave minimum trash yield (6.1 and 6.2 t ha⁻¹), being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to trash yield were significant during both the crop seasons. Genotype CoPant 93227 produced significantly more trash yield (9.9 and 8.5 t ha⁻¹) than that of CoPant 90223 and CoPant 92226 during both the years. Differences in trash yield in CoPant 90223 and CoPant 92226 were not significant during both the years.

Table 13e: Interaction between genotypes and fertilizer levels for cane yield (t ha^{-1})

Genotypes	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
CoPant 90223	61.6	80.2	89.1	60.2	69.1	79.3
CoPant 92226	61.6	75.0	87.3	56.3	63.0	68.2
CoPant 93227	63.4	81.1	93.5	60.6	71.2	80.0
	SEm $\pm$		CD at 5%	SEm $\pm$	C D at 5%	
For comparing two genotypes at same /different levels of Fertilizer	1.7		5.2	1.5	4.6	
For comparing two fertilizer levels at same /different levels of Genotypes	1.5		4.6	1.3	3.9	

Table 13f: Interaction between cropping systems and Genotypes for biological yield (t ha^{-1})

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	124.2	119.1	129.9	101.3	94.8	106.2
Mustard (PR-15) - Spring Sugarcane	99.5	95.1	98.4	90.4	87.2	88.5
Wheat (UP- 2338) - Late Spring Sugarcane	69.1	66.1	67.8	73.3	57.3	65.8
	SEm $\pm$		CD at 5%	SEm $\pm$	C D at 5%	
For comparing two cropping systems/ genotypes	2.0		6.1	1.6	5.1	

Trash yield differed significantly due to NPK level during both the years. Crop fertilized with 125 per cent of recommended NPK produced maximum trash yield of 10.5 and 9.5 t ha⁻¹, being significantly higher than that of 75 and 100 per cent of recommended NPK levels during 1998-2000 and 1999-2001, respectively. The differences in trash yield under 75 and 100 per cent of the recommended NPK were significant where former exhibited lower trash yield (7.5 and 6.6 t ha⁻¹) than later (9.7 and 8.2 t ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.2.6.3 Biological yield

Variations in biological yield due to cropping systems, genotypes and fertilizer (NPK) levels were significant (Appendix XIX & XX). Data (Table 13 & Fig. 8) indicated that autumn season planted sugarcane with mustard intercrop produced significantly higher biological yield (124.9 and 100.7 t ha⁻¹, respectively) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop sequences during both the years. Late spring sugarcane gave minimum biological yield of 67.8 and 65.4 t ha⁻¹, being significantly lower than that of 97.7 and 88.8 t ha⁻¹ under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to biological yield were significant during both the years. CoPant 93227 exhibited significantly higher biological yield (98.8 and 86.7 t ha⁻¹) than that of CoPant 92226 during 1998-2000 and 1999-2001, respectively. Differences in biological yield in CoPant 90223 and

Table 13g: Interaction between cropping systems and fertilizer levels for biological yield ($t\ ha^{-1}$)

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn sugarcane + Mustard (Divya)	98.7	126.8	147.7	87.1	101.7	113.4
Mustard (PR-15) - Spring Sugarcane	80.5	109.5	113.0	78.3	97.4	100.4
Wheat(UP -2338) - Late Spring Sugarcane	56.2	70.6	76.3	55.3	69.4	70.6
	SEm $\pm$		CD at 5 %	SEm $\pm$	C D at 5%	
For comparing two cropping systems at same/ different levels of fertilizer	2.1		6.1	1.4	4.3	
For comparing two fertilizer levels at same /different levels of cropping systems	2.0		5.9	1.3	3.8	

Table 13h: Interaction between genotypes and fertilizer levels for biological yield ($t\ ha^{-1}$)

Genotypes	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
CoPant 90223	77.0	94.5	108.7	71.9	81.3	88.2
CoPant 92226	78.7	100.7	112.4	74.1	85.2	99.7
CoPant 93227	79.7	101.7	115.8	75.0	88.9	100.5
	SEm $\pm$		CD at 5%	SEm $\pm$	C D at 5%	
For comparing two genotypes at same/ different levels of fertilizer	1.6		4.9	1.4	4.3	
For comparing two fertilizer levels at same / different levels of genotypes	1.5		4.7	1.3	3.8	

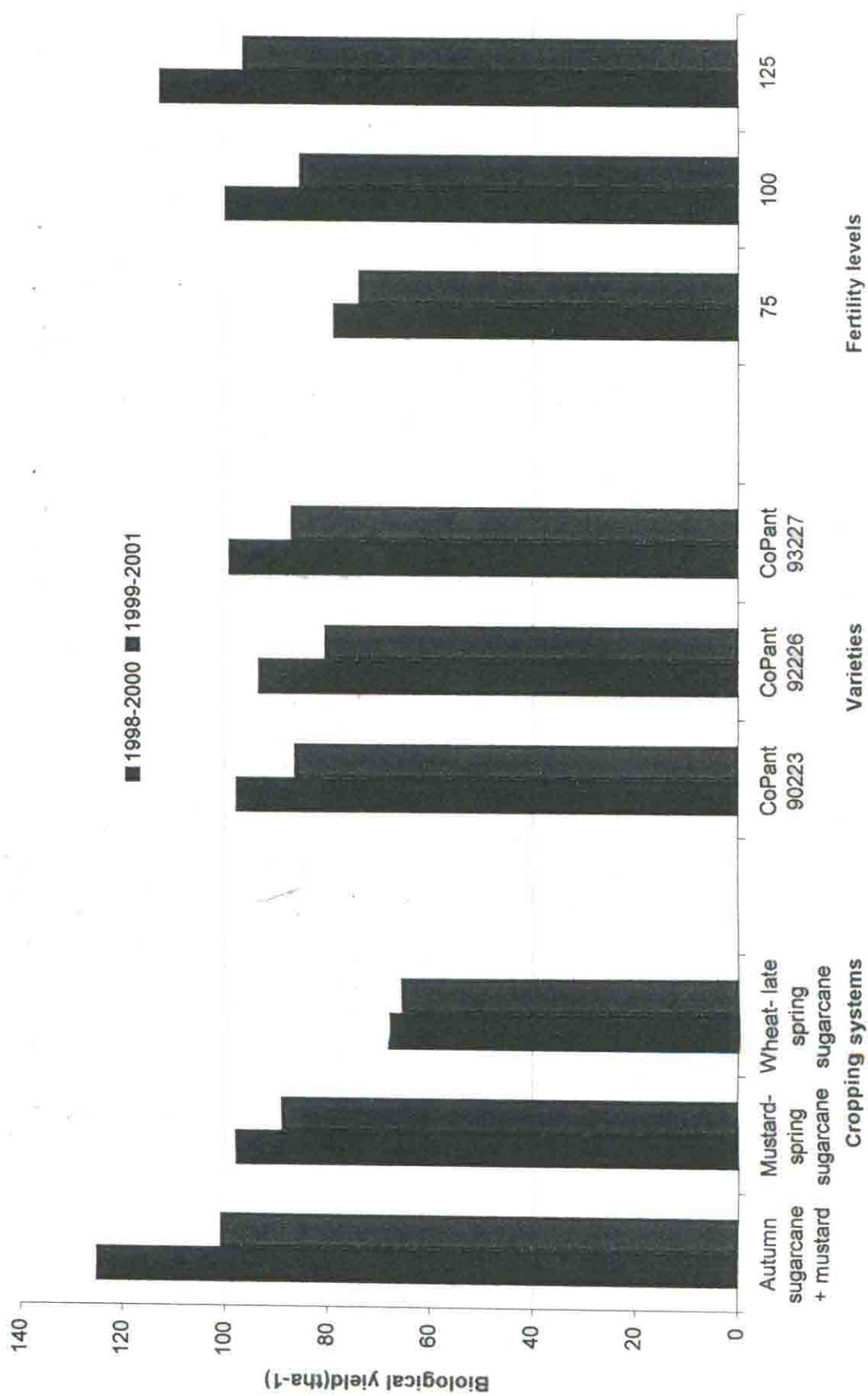


Fig.8: Effect of cropping systems , varieties and fertility levels on biological yield

CoPant 92226 were also significant where former yielded higher (97.4 and 86.0 t ha⁻¹) than later (93.0 and 80.1 t ha⁻¹) during both the years. However, differences in biological yield between CoPant 90223 and CoPant 93227 were not significant during both the years.

Crop fertilized with 125 per cent of recommended NPK produced significantly higher biological yield (112.5 and 96.2 t ha⁻¹) than that of 75 and 100 per cent of the recommended NPK during both the years. Differences in biological yield between 75 and 100 per cent of the recommended NPK levels were also significant where former exhibited lower biological yield (78.4 and 73.5 t ha⁻¹) than later (99.7 and 85.2 t ha⁻¹) during two crop seasons, respectively.

Interactions between cropping systems, genotypes and fertilizer (NPK) levels with respect to biological yield were significant during both the years (Appendix XIX & XX). Data (Table 13f) revealed that during 1998-2000 under autumn sugarcane plus mustard intercrop, CoPant 93227 recorded significantly higher biological yield (129.9 t ha⁻¹) than CoPant 92226. However, in mustard spring sugarcane and wheat-late spring sugarcane crop sequences, differences in biological yield among CoPant 90223, CoPant 93227 and CoPant 92226 were not significant. During 1999-2001, almost similar trend was noted except that differences in biological yield in CoPant 93227 and CoPant 92226 under autumn planted sugarcane plus mustard intercrop were not significant.

Interactions between cropping systems and fertilizer (NPK) levels (Table 13g) revealed that during increasing fertilizer levels from 75 to 125 per cent of

the recommended NPK significantly improved the biological yield under autumn sugarcane + mustard inter crop. However, under mustard-spring sugarcane and wheat-late spring sugarcane, differences in biological yield under 100 and 125 per cent of the recommended NPK levels were not significant but these treatments produced significantly higher biological yield than 75 per cent of the recommended NPK during both the years.

Interactions between genotypes and fertilizer levels with respect to biological yield (Table 13h) revealed that increasing fertilizer (NPK) levels from 75 to 125 per cent of the recommended NPK though improved biological yield of all genotypes but increase was more pronounced in CoPant 92226. Similar trend was observed during both the years.

4.2.6.4 Pooled cane yield analysis

Variation in pooled cane yield due to cropping systems, genotypes and fertilizer levels were significant (Appendix XXXIV). Data (Table 14) indicated that autumn season planted sugarcane intercropped with mustard produced significantly higher cane yield (89.6 t ha^{-1}) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop. Differences in cane yield under spring and late spring season planted sugarcane crop were also significant where former yielded more (74.1 t ha^{-1}) than later (53.3 t ha^{-1}).

Genotypic variations with respect to pooled cane yield analysis were significant. CoPant 93227 exhibited significantly higher cane yield (74.5 t ha^{-1}) than that of CoPant 92226. Differences in pooled cane yield in CoPant 90223

Table 14: Pooled cane yield (tha⁻¹) as influenced by cropping systems, genotypes and fertilizer levels

Treatment		Pooled cane yield (tha⁻¹)
Cropping system		
Autumn Sugarcane + Mustard (Divya)		89.6
Mustard (PR-15) - Spring Sugarcane		74.1
Wheat (UP 2338) - Late Spring Sugarcane		53.3
SEm±		1.08
CD at 5%		3.24
Genotypes		
Co Pant 90223		73.0
Co Pant 92226		70.5
Co Pant 93227		74.5
SEm±		1.08
CD at 5%		3.24
Fertilizer levels (% of recommended NPK)		
75		61.0
100		73.3
125		82.9
SEm±		0.91
CD at 5%		2.62

Table 14a: Interaction between cropping systems and fertilizer levels for pooled cane yield (t ha^{-1})

Cropping systems	% recommended Fertilizer levels		
	75	100	125
Autumn Sugarcane + Mustard (Divya)	73.9	90.8	104.0
Mustard (PR-15) - Spring Sugarcane	63.5	74.3	84.5
Wheat (UP-2338) - Late Spring Sugarcane	45.2	54.6	59.0
		SEm $\pm$	CD at 5%
For comparing two cropping systems at same/different levels of fertilizer		1.68	4.95
For comparing two fertilizer levels at same/ different levels of cropping systems		1.58	4.54

and CoPant 92226 were not significant. However, minimum cane yield (70.0 t ha^{-1}) was recorded in CoPant 92226.

Crop fertilized with 125 per cent of the recommended NPK produced significantly higher cane yield (82.9 t ha^{-1}) than that of 75 and 100 per cent of the recommended NPK. The difference in cane yield between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower cane yield (61.0 t ha^{-1}) than later (73.3 t ha^{-1}).

Interaction between cropping system and fertilizer levels (Appendix XXXIV and Table 14a) revealed that under autumn sugarcane + mustard intercrop and mustard-spring sugarcane crop sequences, crop fertilized with 125 per cent recommended NPK produced significantly higher cane yield (104.0 t ha^{-1}) than that of 75 and 100 per cent of the recommended NPK. However, under wheat-late spring sugarcane crop sequences, differences in cane yield under 100 and 125 per cent of the recommended NPK were not significant.

4.2.6.5 Dry matter accumulation in different plant parts

4.2.6.5.1 In cane

The data on dry matter accumulation in cane (Table 15 and Appendix XXI) revealed that autumn sugarcane intercropped with mustard accumulated significantly higher dry matter in cane (38.6 and 38.0 t ha^{-1}) than that of spring (33.7 and 33.3 t ha^{-1}) and late spring (29.8 and 29.5 t ha^{-1}) planed sugarcane during both the years. The differences in dry matter accumulation in cane

Table 15: Dry matter accumulation in different parts of plants under different treatments at harvesting stage

Treatment	Dry matter (tha ⁻¹)					
	1998-2000			1999-2001		
	Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems						
Autumn Sugarcane + Mustard (Divya)	38.6	3.8	8.2	38.0	3.4	7.6
Mustard (PR-15) - Spring Sugarcane	33.7	3.3	7.3	33.3	2.9	6.7
Wheat (UP 2338) - Late Spring Sugarcane	29.8	2.8	6.4	29.5	2.5	5.9
SEm±	0.91	0.08	0.09	0.16	0.02	0.03
CD at 5%	2.75	0.24	0.28	0.49	0.05	0.11
Genotypes						
Co Pant 90223	33.9	3.2	7.2	33.4	2.9	6.6
Co Pant 92226	35.5	3.5	7.8	35.1	3.1	7.3
Co Pant 93227	32.6	3.1	6.7	32.3	2.8	6.2
SEm±	0.91	0.08	0.09	0.16	0.02	0.03
CD at 5%	NS	0.24	0.28	0.49	0.05	0.11
Fertilizer levels (% of recommended NPK)						
75	33.1	3.1	6.8	32.7	2.7	6.2
100	34.0	3.3	7.2	33.6	2.9	6.7
125	34.9	3.5	7.7	34.6	3.1	7.2
SEm±	0.15	0.03	0.06	0.14	0.01	0.04
CD at 5%	0.45	0.09	0.19	0.42	0.03	0.13

between spring sugarcane and late spring sugarcane was also significant when formed accumulated more dry matter than later.

Among the genotypes, CoPant 92226 exhibited significantly more cane dry matter (35.1 t ha^{-1}) than that of CoPant 90223 (33.4 t ha^{-1}) and CoPant (32.3 t ha^{-1}) during 1999-2001. Differences in dry matter accumulation in cane in CoPant 90223 and CoPant 93227 were also significant during 1999-2001 where former accumulated more dry matter than later. During 1998-2000 differences in cane dry matter in CoPant 90223 and CoPant 93227 were not significant.

Fertilizer levels brought significant variations in dry matter accumulation in cane. Crop fertilized with 125 per cent of the recommended NPK, accumulated significantly higher dry matter than 100 and 75 per cent of the recommended NPK during both the years. Minimum dry matter accumulation (33.1 and 32.7 t ha^{-1}) was recorded under 75 per cent of the recommended NPK, which was significantly lower than that of 100 (34.0 and 33.6 t ha^{-1}) per cent of the recommended NPK during both the crop seasons.

4.2.6.5.2 In green top

The data on dry matter accumulation in green top (Table 15 and Appendix XXI) exhibited that the autumn sugarcane intercropped with mustard produced maximum dry matter in green top (3.8 and 3.4 t ha^{-1}), being significantly higher than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during both the crop seasons. The differences in dry matter production under spring and late spring sugarcane were also significant where

later exhibited lower dry matter (2.8 and 2.5 t ha⁻¹) than former (3.3 and 2.9 t ha⁻¹) during 1998-2000 and 1999-2001.

Genotypic variations in dry matter accumulation in green top were significant during both the years. Genotype CoPant 92226 exhibited significantly higher dry matter production of 3.5 and 3.1 t ha⁻¹ followed by CoPant 90223 (3.2 and 2.9 t ha⁻¹) and CoPant 93227 (3.1 and 2.8 t ha⁻¹) during two crop seasons, respectively.

Crop fertilized with 125 per cent of the recommended NPK attained significantly higher dry matter accumulation than that of 75 and 100 per cent of the recommended NPK during both the years. The variations in dry matter accumulation in green top under 75 and 100 per cent of the recommended NPK were also significant where later exhibited more dry matter in green top (3.5 and 3.1 t ha⁻¹) than former (3.1 and 2.7 t ha⁻¹) during 1998-2000 and 1999-2001, respectively.

4.2.6.5.3 In trash

The data on dry matter accumulation (Table 15 and Appendix XXI) revealed that autumn sugarcane intercropped with mustard exhibited significantly more dry matter in trash (8.2 and 7.6 t ha⁻¹) than that of spring and late spring sugarcane during both the crop seasons.

Late spring sugarcane planted after wheat revealed minimum dry matter production in trash (6.4 and 5.9 g ha⁻¹), being significantly lower than that of autumn sugarcane and spring sugarcane during both the seasons.

Among the genotypes, CoPant 92226 revealed significantly more dry matter accumulation than that of CoPant 90223 and CoPant 93227 during both the years. The differences in trash dry matter in CoPant 90223 and CoPant 93227 were also significant where former gave more dry matter yield (7.8 and 6.6 t ha⁻¹) than later (6.7 and 6.2 t ha⁻¹) during two crop seasons.

Increasing fertilizer from 75 to 125 per cent of the recommended NPK, improved dry matter accumulation in trash during both the crop years. Crop receiving 125 per cent of the recommended NPK recorded maximum dry matter (7.7 and 7.2 t ha⁻¹), being significantly higher than that of 75 (6.8 and 6.2 t ha⁻¹) and 100 per cent (7.2 and 6.7 t ha⁻¹) of the recommended NPK. The differences in 75 and 100 per cent of the recommended NPK were also significant during both the crop seasons.

4.2.7 Extraction per cent

The data presented in Table 16 and Appendix XXII & XXIII revealed that differences in juice extraction due to cropping systems, genotypes and fertilizer levels (Fig. 9) were significant at all the stages during both the years. The extraction per cent decreased with crop age from December to March during both the years.

Autumn planted sugarcane intercropped with mustard exhibited significantly higher juice extraction at all the stages than that of spring sugarcane planted after wheat. The differences in juice extraction between spring sugarcane and late spring sugarcane crop were also significant where former exhibited higher juice extraction than later during both the crop seasons.

Table 16: Juice extraction (%) as influenced by cropping systems, genotypes and fertilizer levels during 1998-2000 and 1999- 2001

Treatment	Extraction (%)							
	December		January		February		March	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems								
Autumn Sugarcane + Mustard (Divya)	54.2	53.4	52.0	52.1	50.2	50.7	48.7	49.6
Mustard (PR-15) - Spring Sugarcane	51.2	50.7	50.0	49.4	48.1	48.1	46.6	46.9
Wheat (UP -2338) - Late Spring Sugarcane	49.3	47.0	47.8	45.7	46.6	44.2	45.8	42.8
SEm±	0.4	0.2	0.4	0.5	0.4	0.5	0.3	0.1
CD at 5%	1.5	0.6	1.3	1.6	1.3	1.6	1.0	0.5
Genotypes								
Co Pant 90223	51.5	50.0	49.8	48.7	48.3	47.2	46.8	46.1
Co Pant 92226	53.0	52.3	50.8	51.0	49.3	49.6	48.0	48.2
Co Pant 93227	50.0	48.9	49.0	47.6	47.5	46.2	46.3	45.0
SEm±	0.4	0.2	0.4	0.5	0.4	0.5	0.3	0.1
CD at 5%	1.5	0.6	1.3	1.6	1.3	1.6	1.0	0.5
Fertilizer levels (% of recommended NPK)								
75	49.0	47.9	48.2	46.6	47.2	45.3	45.7	44.2
100	51.3	50.3	49.5	49.2	48.1	47.7	46.8	46.4
125	54.0	52.8	51.7	51.4	49.7	50.0	48.5	48.7
SEm±	0.7	0.1	0.7	0.6	0.8	0.8	0.6	0.7
CD at 5%	2.2	0.4	2.2	1.9	NS	2.3	1.8	2.1

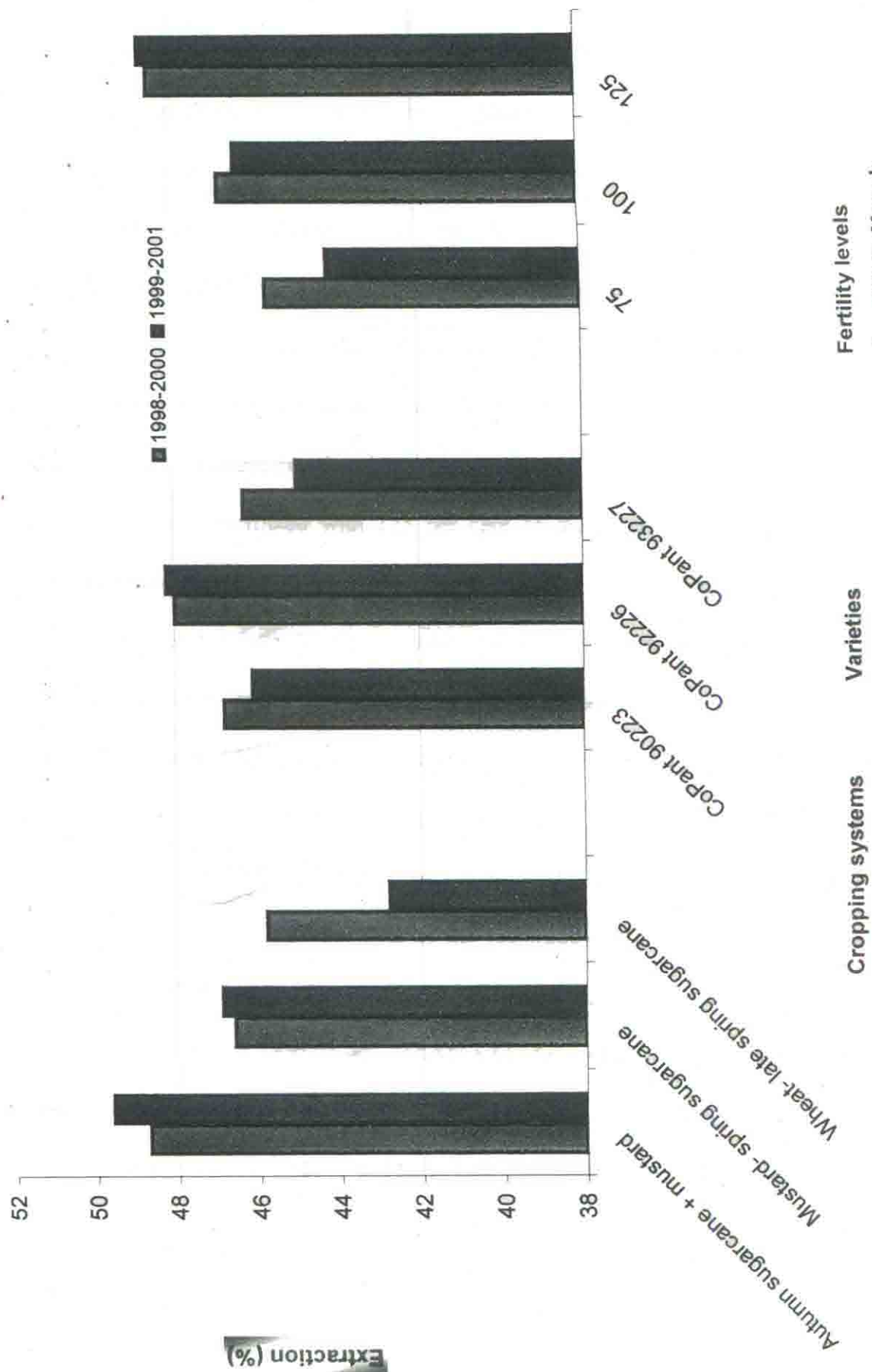


Fig.9: Effect of cropping systems, varieties and fertility levels on extraction(%) in March

Among the genotypes, CoPant 92226 exhibited significantly higher juice extraction than CoPant 90223 and CoPant 93227 at all the stages during 1998-2000 and 1999-2001. In the month of March, maximum juice extraction of 48.0 and 48.2 per cent during two seasons, respectively was recorded with CoPant 92226, being significantly higher than that of CoPant 90223 and CoPant 93227. CoPant 93227, exhibited minimum juice extraction (46.3 and 45.0 per cent) during both the years. The differences in CoPant 90223 and CoPant 93227 in terms of juice extraction were significant during 1999-2001 where former gave higher juice extraction than later.

Crop fertilized with 125 per cent of the recommended NPK exhibited significantly higher juice extraction than that of 75 and 100 per cent of recommended NPK at all the stage during both the years except in February during 1998-2000. During March, crop fertilized with 125 per cent of the recommended NPK levels produced maximum juice extraction of 48.5 and 48.7 per cent, being significantly higher than that of 75 per cent of fertilizer levels during 1998-2000 and 1999-2001, respectively. Differences in juice extraction between 100 and 125 per cent of the recommended NPK were not significant during 1998-2000.

Cropping systems and varietal interaction (Table 16b) at harvesting stage (March) indicated that during 1998-2000 under autumn sugarcane + mustard cropping system, CoPant 92226 exhibited significantly higher juice extraction (50.9 per cent) than that of CoPant 93227 (47.0 per cent) and CoPant 90223

Table 16a: Interaction between cropping systems and genotypes for extraction per cent in December during 1998-2000 and 1999-2001

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	CoPant 90223	CoPant 92226	CoPant 93227	CoPant 90223	CoPant 92226	CoPant 93227
Autumn Sugarcane + Mustard (Divya)	53.9	56.4	52.3	52.8	56.0	51.3
Mustard (PR-15) - Spring Sugarcane	52.6	51.1	50.0	52.6	49.9	49.6
Wheat (UP-2338) - Late Spring Sugarcane	49.6	49.8	48.4	46.9	48.1	45.8
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		0.8	2.5	0.6	2.0	

Table 16b: Interaction between cropping systems and genotypes for extraction (%) in March

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	48.1	50.9	47.0	49.2	52.1	47.6
Mustard (PR-15) - Spring Sugarcane	47.4	46.3	46.1	48.7	46.0	45.7
Wheat (UP-2338) - Late Spring Sugarcane	45.7	46.4	45.4	42.8	43.8	41.7
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems/ genotypes		0.5	1.6	0.3	0.9	

(48.1 per cent). However, in mustard spring sugarcane and wheat-late spring sugarcane cropping systems, genotypes differences with respect to juice extraction were not significant. During 1999-2001, genotype CoPant 92226 gave significantly higher juice extraction than CoPant 93227 and CoPant 90223 in both autumn and late spring seasons. However, in spring seasons, CoPant 90223 gave higher juice extraction than other genotypes.

Interaction between cropping systems and genotypes for juice extraction at other stages was also significant (Table 16a and Appendix XXII & XXIII) and followed similar trend. Interaction between cropping systems and fertilizer levels noted in December during 1999-2001 revealed that crop fertilized with 125 per cent of the recommended of the NPK exhibited significantly higher juice extraction, under autumn sugarcane + mustard and wheat – late spring sugarcane cropping system but under mustard – spring sugarcane, differences in juice extraction between 100 and 125 per cent of the recommended NPK were not significant.

4.2.8 Corrected brix

The data (Table 17 and Appendix XXIV & XXV) exhibited that the differences in corrected brix due to cropping systems, genotypes and NPK levels were significant at all the stages during both the years.

The corrected brix increased with crop age, maximum being in March (Fig. 10) in autumn sugarcane intercropped with mustard. Autumn sugarcane intercropped with mustard, in March produced significantly higher corrected brix

Table 17: Effect of cropping systems, genotypes and fertilizer levels on corrected brix percent

Treatment	Corrected brix (%)							
	1999-2001				1998-2000			
	December	January	February	March	December	January	February	March
Cropping systems								
Autumn Sugarcane +Mustard (Divya)	17.7	18.0	18.6	19.0	17.9	18.2	18.7	19.1
Mustard (PR-15) - Spring Sugarcane	17.0	17.4	17.9	18.1	17.1	17.6	17.9	18.0
Wheat (UP -2338) - Late Spring Sugarcane	16.6	17.0	17.3	17.5	16.6	16.9	17.2	17.6
SEm±	0.13	0.12	0.14	0.26	0.11	0.11	0.12	0.23
CD at 5%	0.41	0.38	0.43	0.80	0.35	0.34	0.36	0.70
Genotypes								
Co Pant 90223	17.3	17.3	18.0	18.0	17.3	17.6	18.0	18.2
Co Pant 92226	17.4	18.0	18.5	19.1	17.6	18.0	18.2	18.9
Co Pant 93227	16.8	17.1	17.4	17.8	16.7	17.1	17.6	17.6
SEm±	0.13	0.12	0.14	0.26	0.11	0.11	0.12	0.23
CD at 5%	0.41	0.38	0.43	0.80	0.35	0.34	0.36	0.70
Fertilizer levels (% of recommended NPK)								
75	17.6	18.0	18.6	18.8	18.0	18.0	18.9	19.0
100	17.2	17.4	18.0	18.0	17.1	17.6	17.8	18.1
125	16.6	17.0	17.2	17.8	16.5	17.0	17.1	17.7
SEm±	0.14	0.13	0.15	0.36	0.24	0.30	0.25	0.31
CD at 5%	0.41	0.38	0.43	1.05	0.71	0.87	0.73	0.90

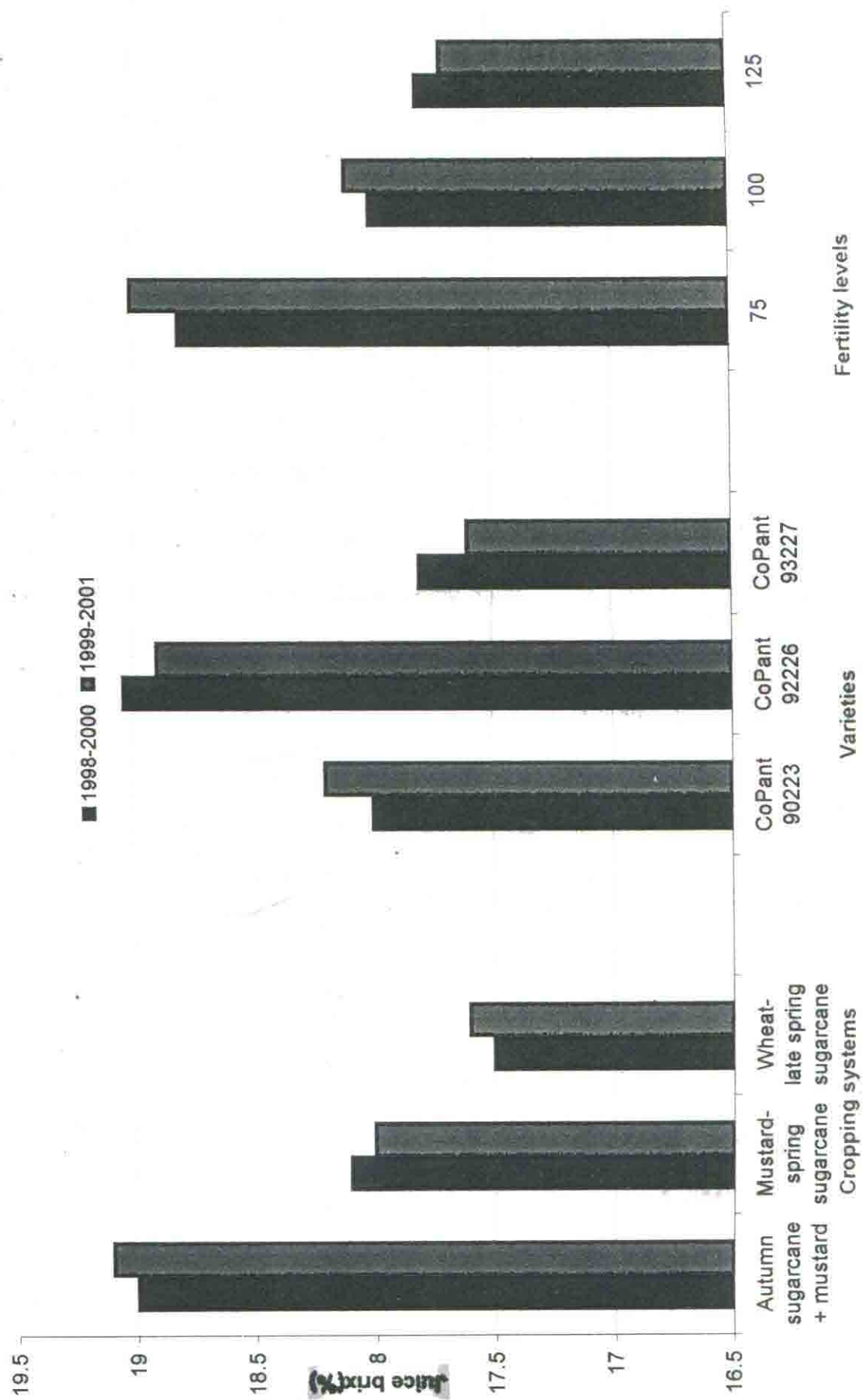


Fig. 10: Effect of cropping systems, varieties and fertility levels on juice brix in March

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(19.0 and 19.1 per cent) than that of spring planted sugarcane (18.1 and 18.0 per cent) and late spring planted sugarcane (17.5 and 17.6 per cent) during both the crop seasons. The differences in corrected brix in spring sugarcane planted after mustard and late spring sugarcane planted after wheat were not significant whereas, minimum was recorded under late spring sugarcane during 1998-2000 and 1999-2001, respectively.

Among the genotypes, CoPant 92226 exhibited significantly higher corrected brix than CoPant 93227 and CoPant 90223 during both the years except in December during 1998-2000 and February in 1999-2001, respectively. In the month of March, maximum corrected brix of 19.1 and 18.9 per cent was recorded with CoPant 92226, being significantly higher than that of CoPant 93227 during both the years. CoPant 93227, exhibited minimum corrected brix (17.8 and 17.6 per cent). The differences in CoPant 90223 and CoPant 93227 in terms of corrected brix were significant during both the years except in December during 1998-2000 and February in 1998-2001.

Crop fertilized with 125 per cent of the recommended NPK exhibited significantly lower corrected brix than that of 75 and 100 per cent of the recommended NPK at all the stages during both the years. During March, crop fertilized with 125 per cent of the recommended NPK levels produced minimum corrected brix of 17.8 and 17.7 per cent, being significantly lower than that of 75 and 100 per cent of the fertilizer levels during 1998-2000 and 1999-2001, respectively. Differences in corrected brix between 100 and 125 per cent of the

recommended NPK levels were significant during 1998-2000 except March and not significant during 1999-2001, respectively.

4.2.9 Sucrose per cent

The data (Table 18 and Appendix XXVI & XXVII) revealed that the differences in juice sucrose due to cropping systems, genotypes and fertilizer levels (Fig. 11) were significant at all the stages during both the years except in February and March during 1998-2000.

The juice sucrose increased with crop age, maximum being in March and minimum in December. During 1999-2001, autumn sugarcane intercropped with mustard exhibited significantly higher juice sucrose (16.9 per cent) than that of late spring planted sugarcane after wheat (16.0 per cent). Differences in juice sucrose between spring and late spring planted sugarcane crops were not significant. Similar trend was noted at other crop growth stages.

Among the genotypes, CoPant 92226 recorded significantly higher juice sucrose (17.0 per cent) than that of CoPant 93227 (16.1 per cent) during March in 1999-2001. Differences in juice sucrose in CoPant 90223 and CoPant 92226 were however, not significant. Similar trend was noted at other stages.

Variations in juice sucrose due to fertilizer levels were significant at all stages of crop growth except in December during 1999-2001. Crop fertilized with 75 per cent of the recommended NPK exhibited significantly higher juice sucrose than that of 125 per cent of the recommended NPK at all the stages during both the crop seasons. During March, crop fertilized with 75 per cent of

Table18: Juice sucrose (%) influenced by cropping systems, genotypes and fertilizer levels

Treatment	Sucrose (%)									
	December		January		February		March			
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems										
Autumn Sugarcane + Mustard (Divya)	13.8	14.2	14.1	14.7	15.0	15.2	17.5	16.9		
Mustard (PR-15) - Spring Sugarcane	13.1	13.5	13.5	13.8	14.5	14.2	17.3	16.4		
Wheat (UP-2338) - Late Spring Sugarcane	12.6	12.7	13.0	13.4	14.0	13.9	16.6	16.2		
SEm±	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3		
CD at 5%	0.7	0.7	0.6	0.6	NS	0.9	NS	0.9		
Genotypes										
Co Pant 90223	13.3	13.7	13.5	14.2	14.4	14.6	17.0	16.3		
Co Pant 92226	13.6	13.8	14.1	14.3	15.0	14.8	17.7	17.0		
Co Pant 93227	12.8	12.9	13.1	13.4	14.3	13.9	16.7	16.1		
SEm±	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3		
CD at 5%	0.7	0.7	0.6	0.6	NS	0.9	NS	0.9		
Fertilizer levels (% of recommended NPK)										
75	13.7	14.0	14.0	14.6	14.9	15.2	17.9	17.8		
100	13.1	13.5	13.6	14.0	14.5	14.4	17.1	16.4		
125	12.7	12.9	13.0	13.3	14.1	13.7	16.4	15.3		
SEm±	0.2	0.4	0.2	0.1	0.2	0.4	0.3	0.4		
CD at 5%	0.6	NS	0.7	0.4	NS	1.3	0.9	1.2		

Table 18a: Interaction between cropping systems and genotypes for juice sucrose (%) in March

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	17.5	18.0	16.9	16.8	17.3	16.4
Mustard (PR-15) - Spring Sugarcane	17.0	17.5	17.3	16.1	17.0	16.2
Wheat (UP-2338) - Late Spring Sugarcane	16.9	16.1	16.3	16.1	15.8	16.0
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems/ genotypes		0.1	0.3	0.06	0.19	

Table 18b: Interaction between cropping systems and fertilizer levels for juice sucrose (%) in March

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	18.2	17.5	16.8	18.2	17.0	15.6
Mustard (PR-15) - Spring Sugarcane	17.9	17.3	16.7	17.7	16.4	15.3
Wheat (UP-2338) - Late Spring Sugarcane	17.4	16.5	15.8	17.2	16.0	15.0
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems at same/different levels of fertilizer		0.05	0.15	0.06	0.19	
For comparing two fertilizer levels at same/ different levels of cropping systems		0.05	0.16	0.06	0.18	

Table 18c: Interaction between genotypes and fertilizer levels for juice sucrose (%) in March

Genotypes	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
CoPant 90223	17.7	17.1	16.3	17.3	16.2	15.4
CoPant 92226	17.5	18.4	16.9	17.2	18.0	15.7
CoPant 93227	17.5	16.5	16.1	17.0	15.8	15.2
		SEm $\pm$	CD at 5%	SEm $\pm$	C D at 5%	
For comparing two genotypes at same/ different levels of fertilizer		0.05	0.15	0.06	0.19	
For comparing two fertilizer levels at same /different levels of genotypes		0.05	0.16	0.06	0.18	

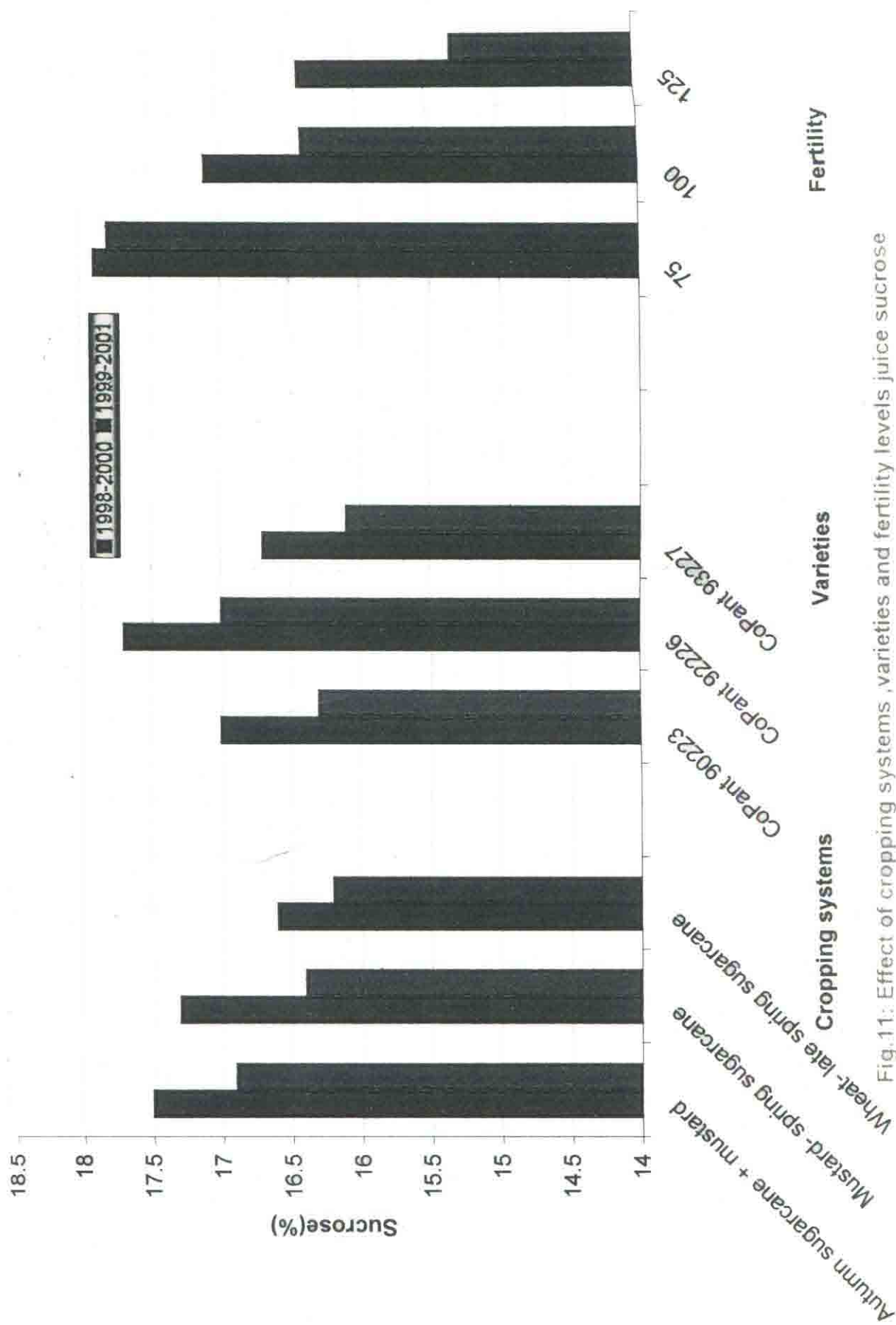


Fig.11: Effect of cropping systems , varieties and fertility levels juice sucrose

the recommended NPK levels exhibited maximum juice sucrose of 17.9 and 17.8 per cent, being significantly higher than that of 125 per cent of the recommended NPK (16.4 and 15.3 per cent) during both the years, respectively. The differences in juice sucrose in 75 and 100 per cent of the recommended NPK during 1998-2000 were not significant but during 1999-2001 former exhibited significantly higher juice sucrose (17.8 per cent) than later (16.4 per cent). The differences in juice sucrose between 100 and 125 per cent of the recommended NPK were not significant during both the years.

The interaction between cropping systems and genotypes (Table 18a) revealed that during 1998-2000 in March, CoPant 92226 produced significantly higher juice sucrose (18.0 per cent) than that of CoPant 93227 (16.9 per cent) and CoPant 90223 (17.5 per cent) under autumn sugarcane + mustard inter crop sequence. However, under mustard – spring sugarcane and wheat – late spring sugarcane crop sequence, difference in juice sucrose in CoPant 92226 and CoPant 93227 were not significant. Almost similar trend was noted in February during 1998-2000 except that differences in juice sucrose in CoPant 92226 and CoPant 93227 were also significant under mustard – spring sugarcane crop sequence. Interaction between cropping systems and fertilizer levels (Table 18b) indicated that during 1998-2000, under 125 per cent of the recommended NPK, both autumn and spring seasons sugarcane exhibited statistically same juice sucrose (16.8 per cent) but significantly higher than that of late spring sugarcane (15.8 per cent). However, under 75 and 100 per cent of the recommended NPK,

autumn sugarcane exhibited significantly higher juice sucrose (18.2 per cent) than that of spring sugarcane (17.9 per cent) and late spring sugarcane (17.4 per cent). The above interaction was though significant during 1999-2001 but did not follow definite trend.

Varietal and fertilizer interaction (Table 18c) noted in March during 1998-2000 revealed that CoPant 90223 exhibited significantly higher juice sucrose (17.7 per cent) than CoPant 92226 and CoPant 93227 under 75 per cent of the recommended fertilizer levels. However, under 100 and 125 per cent of the recommended NPK, CoPant 92226 exhibited significantly higher juice sucrose (18.4 per cent) than that CoPant 90223 and CoPant 93227. Almost similar trend was recorded during 1999-2001 except that differences in juice sucrose between CoPant 90223 and CoPant 92226 under 75 per cent of the recommended NPK were not significant.

4.2.10 Purity coefficient

The data (Table 19 and Appendix XXVIII & XXIX) revealed that the differences in purity coefficient due to cropping systems, genotypes and fertilizer levels were significant at all the crop growth stages during 1998-2000 and 1999-2001.

The juice purity increased with crop age, maximum being in March and minimum in December. During March, autumn planted sugarcane intercropped with mustard (Fig. 12) exhibited significantly higher juice purity of 80.5 and 82.7 per cent than that of spring sugarcane planted after mustard harvest and late

Table 19: Purity coefficient (%) of juice as influenced by cropping systems, genotypes and fertilizer levels

Treatment	Purity coefficient (%)							
	December		January		February		March	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems								
Autumn Sugarcane + Mustard (Divya)	80.1	79.5	80.5	81.8	81.6	83.9	80.5	82.7
Mustard (PR-15) - Spring Sugarcane	77.6	77.9	78.4	80.4	80.5	82.4	79.5	81.0
Wheat (UP-2338) - Late Spring Sugarcane	71.4	76.4	72.6	78.6	74.9	80.3	72.6	79.5
SEm±	0.5	0.1	0.4	0.2	0.4	0.1	0.4	0.3
CD at 5%	1.5	0.4	1.3	0.7	1.2	0.4	1.3	0.9
Genotypes								
Co Pant 90223	76.9	77.8	77.9	80.4	79.8	82.2	78.2	80.7
Co Pant 92226	78.0	79.8	78.4	81.8	80.3	83.9	78.6	82.9
Co Pant 93227	74.2	76.2	75.1	78.5	76.9	80.5	75.8	79.6
SEm±	0.5	0.1	0.4	0.2	0.4	0.1	0.4	0.3
CD at 5%	1.5	0.4	1.3	0.7	1.2	0.4	1.3	0.9
Fertilizer levels (% of recommended dose)								
75	78.3	79.2	79.2	81.7	80.6	83.7	79.1	82.5
100	76.3	77.9	77.0	80.2	78.7	82.1	77.6	80.8
125	74.4	76.8	75.3	78.8	77.7	80.8	75.9	79.9
SEm±	0.7	0.6	0.8	0.3	0.8	0.6	0.8	0.5
CD at 5%	2.1	1.8	2.4	1.1	2.4	1.9	2.7	1.6

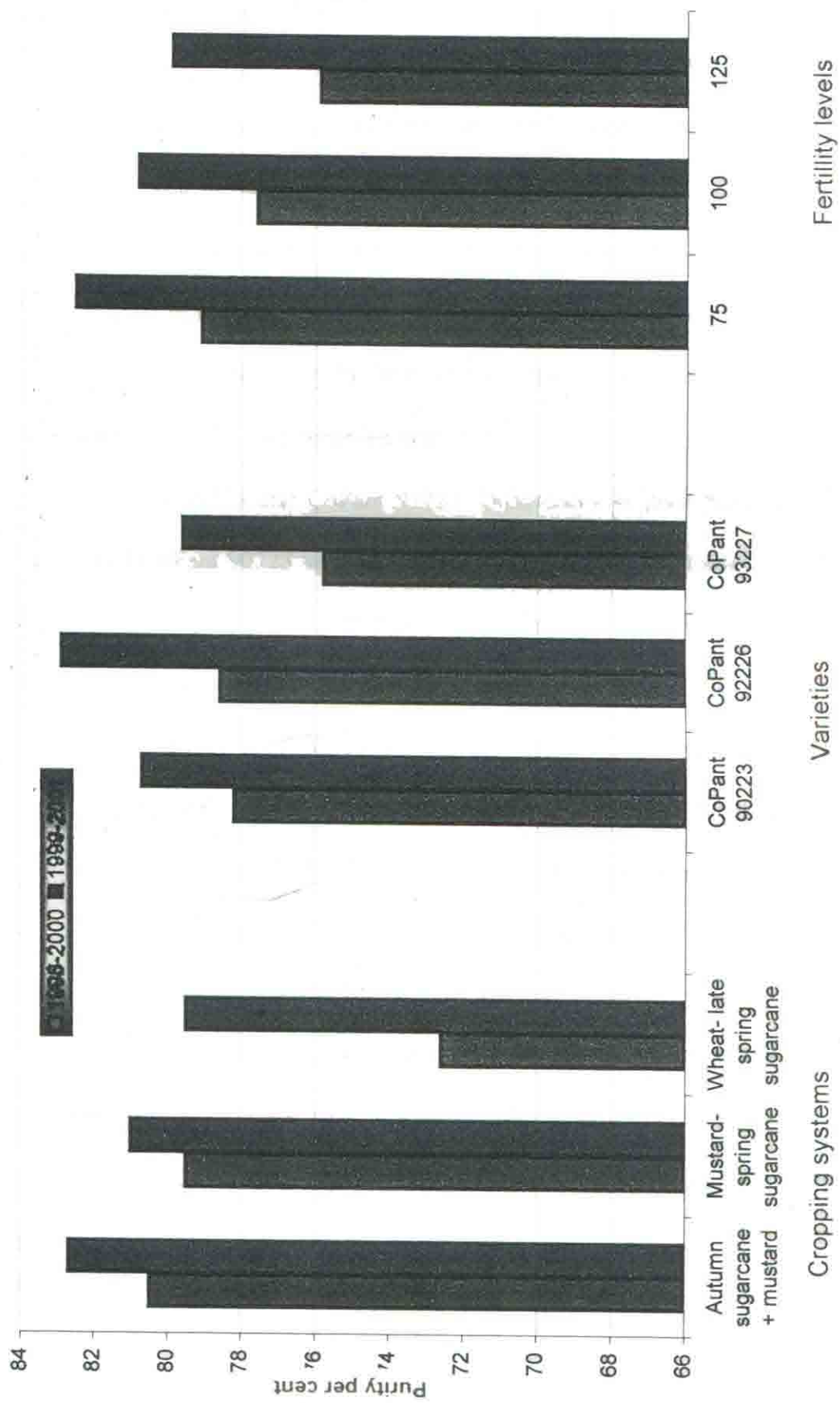


Fig.12: Effect of cropping systems, varieties and fertility levels on purity per cent

spring sugarcane planted after wheat during both the years, respectively. The differences in juice purity in spring and late spring planted crops were also significant where later exhibited lower juice purity (72.6 and 79.5 per cent) than former (79.5 and 81.0 per cent) during two crops season, respectively. Similar trend was observed at other stages.

Genotypic variations indicated that CoPant 92226 recorded significantly higher juice purity than that of CoPant 90223 and CoPant 93227 at all the stages during both the years. In the month of March, maximum juice purity of 78.6 and 82.9 per cent was recorded with CoPant 92226, being significantly higher than CoPant 90223 and CoPant 93227. Differences in juice purity in CoPant 93227 and CoPant 90223 were also significant where later recorded higher juice purity (75.8 and 79.6 per cent) than former (78.2 and 80.7 per cent) during two crop season, respectively.

Crop fertilized with 75 per cent of recommended NPK recorded significantly higher juice purity than that of 100 and 125 per cent of NPK levels at all the crop growth stages during both the years. During the month of March, crop fertilized with 75 per cent of the recommended fertilizer levels exhibited maximum juice purity of 79.1 and 82.5 per cent, being significantly higher than that of 100 (77.6 and 80.8 per cent) and 125 per cent (75.9 and 79.9 per cent) of NPK during 1998-2000 and 1999-2001, respectively. The differences in juice purity under 100 and 125 per cent of the recommended NPK were also significant, where later produced lower juice purity than former.

Table 19a: Interaction between cropping systems and genotypes for purity coefficient (%)
in February

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	81.8	82.8	80.1	83.8	86.2	81.7
Mustard (PR-15) - Spring Sugarcane	81.2	80.8	79.5	82.8	81.6	81.0
Wheat (UP-2338) - Late Spring Sugarcane	76.9	77.0	71.1	80.3	81.2	78.9
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		0.7	2.1	0.5	1.5	

Table 19b: Interaction between cropping systems and genotypes for purity coefficient (%) in
March

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	80.3	81.4	79.8	82.6	84.8	80.7
Mustard (PR-15) - Spring Sugarcane	80.2	79.4	78.8	82.0	80.5	79.9
Wheat (UP-2338) - Late Spring Sugarcane	74.0	75.0	68.8	79.1	81.0	78.2
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems/ genotypes		0.7	2.3	0.5	1.5	

The interaction between cropping systems and genotypes was significant in the months of February and March during both the crop season (Appendix XXVIII). Data revealed that during 1998-2000 (Table 19b) in the month of March, all genotypes exhibited statistically similar juice purity under autumn and spring seasons. However, under late planting after wheat, genotypes CoPant 90223 and CoPant 92226, being at par exhibited significantly higher juice purity than CoPant 93227. Interaction between cropping systems and genotypes for juice purity was though significant but did not follow definite trend. Similar trend was noted in the month of February (Table 19a) during both the years.

4.2.11 Reducing sugars

The data (Table 20 and Appendix XXX & XXXI) revealed that the differences in reducing sugar due to different treatments were significant at all the crop growth stages during both the years of crop season.

The reducing sugars decreased with crop age, maximum being during December and minimum during March. At harvesting stage (March), late spring sugarcane planted after wheat exhibited significantly higher juice reducing sugars than autumn sugarcane + mustard and spring sugarcane following mustard crop during both the years. The differences in reducing sugars between autumn season planted sugarcane and spring season planted sugarcane were also significant where former exhibited lower reducing sugars than later during two crop seasons.

Table 20: Reducing sugars (%) of juice as influenced by cropping systems, genotypes and fertilizer levels during different months

Treatment	Reducing sugars (%)							
	December		January		February		March	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems								
Autumn Sugarcane + Mustard (Divya)	1.36	1.35	1.19	1.21	1.03	1.02	0.86	0.90
Mustard (PR-15) - Spring Sugarcane	1.45	1.47	1.28	1.25	1.10	1.08	0.95	0.96
Wheat (UP -2338) - Late Spring Sugarcane	1.68	1.65	1.51	1.40	1.12	1.14	1.00	0.99
SEm±	0.02	0.01	0.01	0.009	0.006	0.009	0.007	0.007
CD at 5%	0.06	0.03	0.03	0.026	0.019	0.028	0.021	0.021
Genotypes								
Co Pant 90223	1.45	1.48	1.29	1.24	1.06	1.06	0.93	0.91
Co Pant 92226	1.30	1.31	1.20	1.15	1.00	1.01	0.87	0.90
Co Pant 93227	1.74	1.69	1.50	1.47	1.16	1.17	0.99	1.01
SEm±	0.02	0.01	0.01	0.009	0.006	0.009	0.007	0.007
CD at 5%	0.06	0.03	0.03	0.026	0.019	0.028	0.021	0.021
Fertilizer levels (% of recommended NPK)								
75	1.39	1.42	1.25	1.24	1.02	1.04	0.88	0.90
100	1.51	1.49	1.33	1.29	1.08	1.10	0.94	0.95
125	1.60	1.57	1.40	1.33	1.11	1.12	1.00	0.98
SEm±	0.02	0.02	0.02	0.005	0.016	0.013	0.017	0.012
CD at 5%	0.06	0.06	0.06	0.016	0.048	0.039	0.051	0.037

Among the genotypes, CoPant 93227 recorded significantly higher reducing sugars than CoPant 90223 and CoPant 92226 at all the stages of crop growth. In the month of March, maximum reducing sugar of 0.99 and 1.01 per cent were recorded in CoPant 93227, being significantly higher than that of CoPant 90223 and CoPant 92226 during two years, respectively. Genotype CoPant 92226, however, exhibited minimum reducing sugars of 0.87 and 0.90 per cent during 1998-2000 and 1999-2001, respectively, being significantly lower than that of CoPant 90223 and CoPant 93227.

Crop fertilized with 125 per cent of recommended fertilizer levels produced significantly higher reducing sugars than that of 75 and 100 per cent of the recommended fertilizer at all the stages. During March, crop fertilized with 125 per cent of the recommended fertilizer contained maximum reducing sugars (1.00 and 0.98 per cent), being significantly higher than that of 100 and 75 per cent of recommended fertilizer levels during both the years, respectively. Crop fertilized with 75 per cent of recommended fertilizer contained minimum reducing sugars (0.88 and 0.90 per cent), being significantly lower than that of 100 and 125 per cent of the recommended fertilizer during 1998-2200 and 1999-2001, respectively.

The interaction between cropping systems and genotypes was though significant in the month of December, January, February and March but did not follow definite trend.

Table 21: Available sugar (%) in cane juice as influenced by cropping systems, genotypes and fertilizer levels

Treatment	Available sugar (%)									
	December		January		February		March			
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems										
Autumn Sugarcane + Mustard (Divya)	9.0	9.3	9.2	9.8	10.0	10.1	12.2	12.7		
Mustard (PR-15) - Spring Sugarcane	8.4	8.7	8.6	8.9	9.4	9.3	12.1	11.5		
Wheat (UP-2338) - Late Spring Sugarcane	8.1	8.0	8.2	8.7	9.0	9.0	11.5	11.1		
SEm±	0.11	0.20	0.07	0.23	0.10	0.23	0.17	0.11		
CD at 5%	0.35	0.63	0.22	0.70	0.30	0.69	0.51	0.33		
Genotypes										
Co Pant 90223	8.5	8.8	8.7	9.4	9.3	9.7	11.9	12.0		
Co Pant 92226	8.8	8.9	9.1	9.4	9.8	9.7	12.3	12.1		
Co Pant 93227	8.1	8.2	8.2	8.6	9.3	9.0	11.7	11.5		
SEm±	0.11	0.20	0.07	0.23	0.10	0.23	0.17	0.11		
CD at 5%	0.35	0.63	0.22	0.70	0.30	0.69	0.51	0.33		
Fertilizer levels (% of recommended NPK)										
75	8.9	9.1	9.1	9.7	9.8	10.0	12.6	12.1		
100	8.4	8.6	8.7	9.1	9.5	9.4	11.9	11.8		
125	8.1	8.2	8.2	8.7	9.2	8.9	11.4	11.4		
SEm±	0.14	0.30	0.15	0.33	0.21	0.35	0.40	0.10		
CD at 5%	0.42	0.90	0.46	0.97	NS	1.04	NS	0.30		

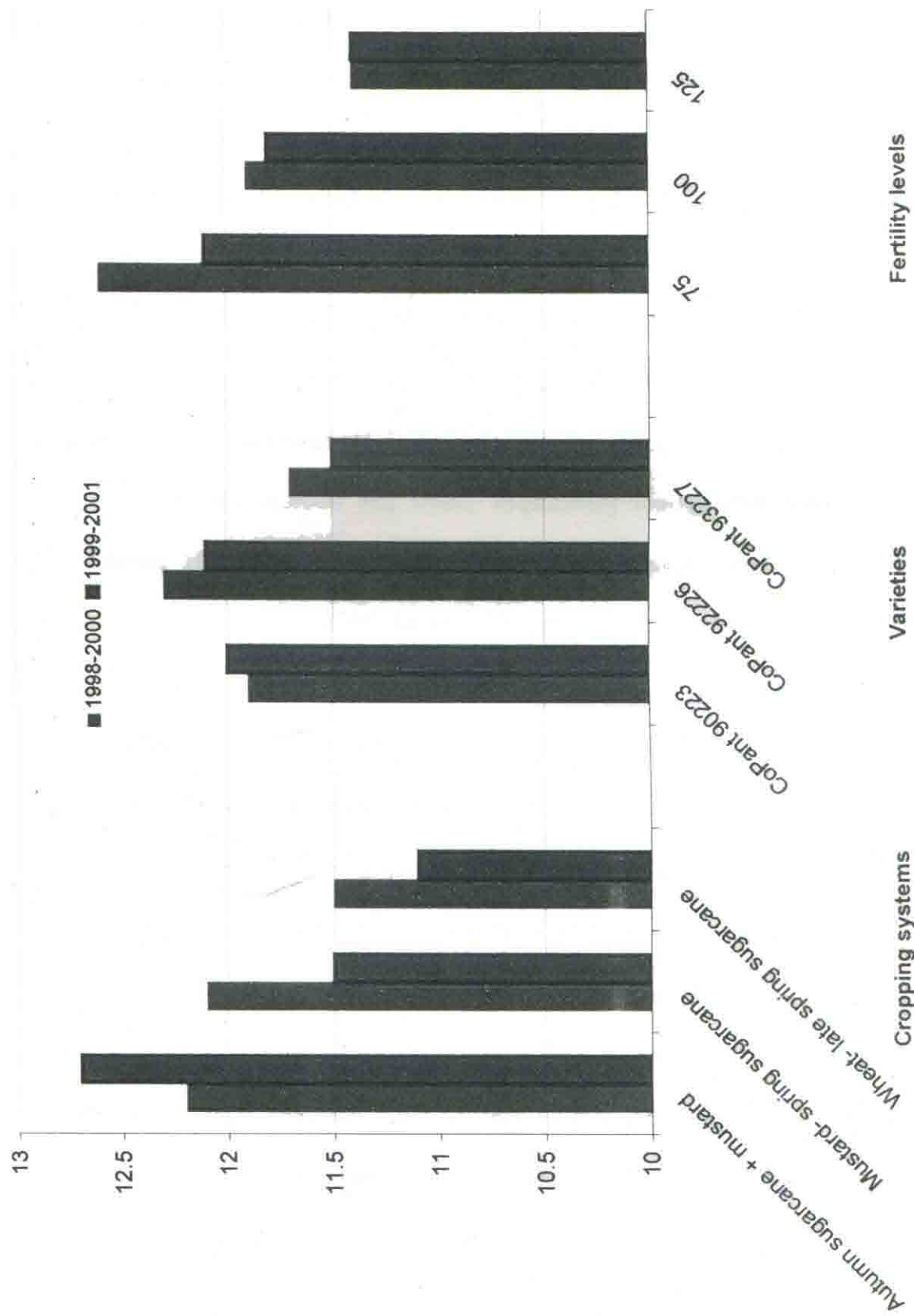


Fig.13: Effect of cropping systems , varieties and fertility levels on available sugar(March)

4.2.12 Available sugar

The data presented in Table 21 and Appendix XXXII & XXXIII indicated that differences in available sugar due to cropping systems and genotypes were significant at all the stages of crop growth during both the crop seasons. The available sugar increased with crop age, from December to March.

At harvesting stage (March), autumn sugarcane intercropped with mustard (Fig. 13) accumulated significantly higher available sugar (12.7 per cent) than that spring sugarcane (11.5 per cent) and late spring sugarcane (11.1 per cent) planted after mustard and wheat, respectively during 1998-2000. However, during 1999-2001 autumn and spring season sugarcane planted crops exhibited statistically same available sugar (12.2 and 12.1 per cent) but higher than that of late spring sugarcane (11.5 per cent). Almost similar trend was noted at other stages during both the years.

Among the genotypes, CoPant 92226, being at par with that CoPant 90223 recorded significantly higher available sugar than that of CoPant 93227 at all the stages during both the years. During March, maximum available sugar of 12.3 and 12.1 per cent was recorded with CoPant 92226, being significantly higher than that of CoPant 93227 during 1998-2000 and 1999-2001, respectively. Differences in available sugar between CoPant 90223 and CoPant 92226 were not significant. Differences in available sugar in CoPant 90223 and CoPant 93227 were significant during 1999-2001, where former accumulated more sugar

Table 21a: Interaction between cropping systems and genotypes for available sugar (%) at harvesting (March)

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	12.1	12.6	12.0	12.8	13.2	12.2
Mustard (PR-15) - Spring Sugarcane	12.0	12.3	11.8	11.4	11.8	11.3
Wheat (UP-2338) - Late Spring Sugarcane	12.3	11.3	11.0	11.3	11.0	10.8
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		0.2	0.6	0.1	0.4	

Table 21 b: Interaction between cropping systems and fertilizer levels for available sugar (%) at harvesting (March)

Cropping systems	% of recommended NPK levels					
	1998-2000			1999-2001		
	75	100	125	75	100	125
Autumn Sugarcane + Mustard (Divya)	13.0	12.5	12.2	13.3	12.8	12.1
Mustard (PR-15) - Spring Sugarcane	12.3	12.0	11.5	11.8	11.5	11.2
Wheat (UP-2338) - Late Spring Sugarcane	11.7	11.5	10.9	11.3	11.1	10.8
		SEm±	CD at 5%	SEm±	C D at 5%	
For comparing two cropping systems at same/different levels of fertilizer		0.2	0.6	0.1	0.4	
For comparing two fertilizer levels at same/different levels of cropping systems		0.2	0.6	0.1	0.3	

(12.0 per cent) than later (11.5 per cent). Almost similar trend was noted at other growth stages.

Variations in available sugar due to fertilizer levels were significant at all the stages except in February and March during 1998-2000. At harvesting (March), crop fertilized with 75 per cent of the recommended NPK accumulated maximum cane available sugar (12.1 per cent), being significantly higher than 100 and 125 per cent of the recommended NPK during 1999-2001. Differences in available sugar in 100 and 125 per cent of the recommended NPK were also significant where former recorded higher available sugar (11.8 per cent) than later (11.4 per cent). Similar trend was noted at other stages.

The interaction between cropping systems, genotypes and fertilizer levels were significant in December, February and March during both the years (Appendix XXXII & XXXIII). Interaction between cropping system and genotypes (Table 21a) at harvesting (March) revealed that during 1998-2000, under autumn sugarcane + mustard intercropped crop sequences, CoPant 92226, being at par with CoPant 90223, exhibited significantly higher available sugar than that of CoPant 93227. However, under mustard – spring sugarcane sequence, genotypes did not differ significantly. Under late spring sugarcane planted after wheat, CoPant 93227 recorded significantly lower available sugar than that of CoPant 90223. Almost similar trend was noted during 1999-2001.

Interaction between cropping systems and fertilizer levels (Table 21b) revealed that during 1998-2000, under wheat – late spring sugarcane crop

sequences, crop fertilized with 125 per cent of the recommended NPK exhibited significantly lower available sugar (10.9 per cent) than that of 75 and 100 per cent of the recommended NPK. However, under autumn sugarcane + mustard inter cropping and mustard – spring sugarcane crop sequence, differences in available sugar between 100 and 125 of the recommended of NPK were not significant. During 1999-2001, though above interaction was significant but did not follow definite trend. Similar trend was noted during December and February months of observations.

4.2.13 Commercial cane sugars

Genotype CoPant 93227 yielded significantly higher (Table 22) commercial cane sugar (9.7 t ha^{-1}) than CoPant 90223 (9.2 t ha^{-1}) and CoPant 92226 (8.8 t ha^{-1}) during 1998-2000. However, during 1999-20001, differences in commercial cane stages in CoPant 93227 and CoPant 90223 were not significant genotype CoPant 92226. However produced significantly lower sugars yield (8.8 and 7.3 t ha^{-1}) than rest of the genotypes during both the years.

Sugars yield differed significantly due to NPK levels during both the crop seasons. Crop fertilized with 125 per cent of recommended NPK produced maximum commercial cane sugars of 10.3 and 9.0 t ha^{-1} , being significantly higher than that of 75 and 100 per cent of the recommended NPK during both the years, respectively. The differences in cane sugars under 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower

Table 22: Commercial cane sugar at harvest influenced by cropping systems, genotypes and fertilizer levels

Treatment	Commercial cane sugar (tha ⁻¹)	
	1998-2000	1999-2001
Cropping systems		
Autumn Sugarcane + Mustard (Divya)	12.0	10.3
Mustard (PR-15) - Spring Sugarcane	9.5	8.2
Wheat (UP -2338) - Late Spring	6.3	5.8
Sugarcane		
SEm±	0.1	0.2
CD at 5%	0.4	0.6
Genotypes		
Co Pant 90223	9.2	8.4
Co Pant 92226	8.8	7.3
Co Pant 93227	9.7	8.5
SEm±	0.1	0.2
CD at 5%	0.4	0.6
Fertilizer levels (% of recommended NPK)		
75	7.9	7.1
100	9.5	8.1
125	10.3	9.0
SEm±	0.2	0.2
CD at 5%	0.7	0.6

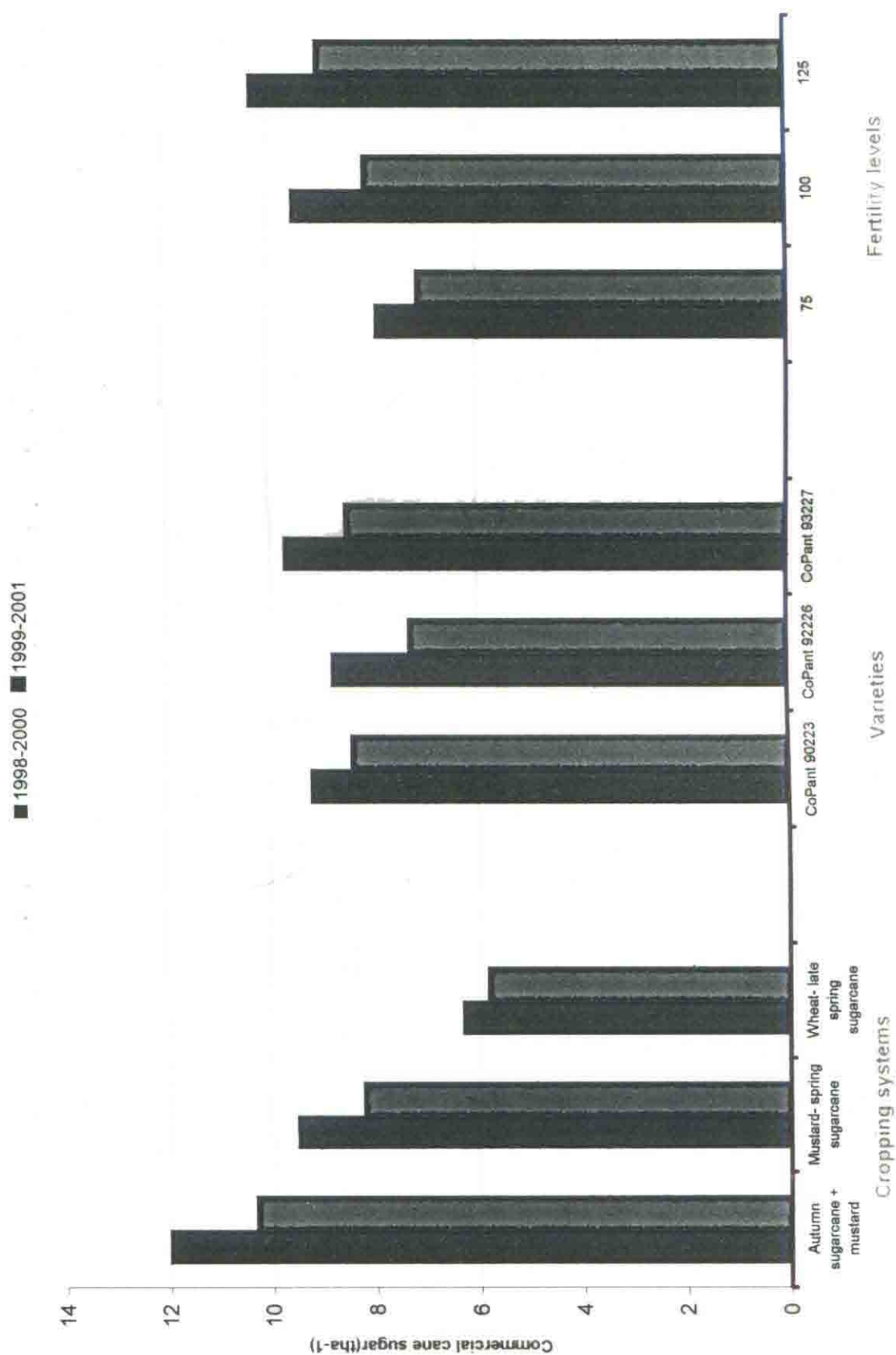


Fig.14: Effect of cropping systems, varieties and fertility levels on commercial cane sugar

Table 22a: Interaction effect of cropping systems and genotypes on commercial cane sugar
(t ha⁻¹) at harvest

Cropping systems	Genotypes					
	1998-2000			1999-2001		
	Co Pant 90223	Co Pant 92226	Co Pant 93227	Co Pant 90223	Co Pant 92226	Co Pant 93227
Autumn Sugarcane + Mustard (Divya)	11.2	11.0	12.6	10.4	9.0	11.3
Mustard (PR-15) - Spring Sugarcane	9.7	8.9	9.2	8.3	7.9	8.1
Wheat (UP-2338) - Late Spring Sugarcane	6.7	6.0	6.1	6.7	4.8	5.9
		SEm±	CD at 5%	SEm ±	C D at 5%	
For comparing two cropping systems/ genotypes		0.24	0.71	0.27	0.83	

Table23: Juice pH as influenced by cropping systems, genotypes and fertilizer levels

Treatment	pH							
	December		January		February		March	
	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001	1998-2000	1999-2001
Cropping systems								
Autumn Sugarcane + Mustard (Divya)	5.36	4.99	5.41	5.05	5.49	5.08	5.40	5.07
Mustard (PR-15) - Spring Sugarcane	5.40	5.06	5.40	5.09	5.50	5.05	5.39	5.00
Wheat (UP-2338) - Late Spring Sugarcane	5.37	5.06	5.42	5.03	5.53	5.00	5.40	5.00
SEm±	0.02	0.016	0.014	0.017	0.019	0.026	0.04	0.02
CD at 5%	NS	0.049	NS	0.052	NS	0.080	NS	0.06
Genotypes								
Co Pant 90223	5.38	5.05	5.40	5.06	5.51	5.09	5.40	5.07
Co Pant 92226	5.40	5.03	5.42	5.06	5.52	5.05	5.40	5.02
Co Pant 93227	5.36	5.00	5.40	5.00	5.49	5.00	5.38	5.00
SEm±	0.02	0.016	0.014	0.017	0.019	0.026	0.04	0.02
CD at 5%	NS	0.049	NS	0.052	NS	0.080	NS	0.06
Fertilizer levels (% of recommended NPK)								
75	5.30	5.01	5.36	5.01	5.42	4.99	5.33	4.85
100	5.37	5.03	5.41	5.05	5.54	5.06	5.39	5.00
125	5.50	5.10	5.50	5.09	5.57	5.09	5.47	5.02
SEm±	0.02	0.025	0.013	0.021	0.017	0.019	0.028	0.017
CD at 5%	0.06	0.075	0.037	0.063	0.051	0.057	0.081	0.051

commercial cane sugars (7.9 and 7.1 t ha⁻¹) than later (9.5 and 8.2 t ha⁻¹), during 1998-2000 and 1999-2001, respectively.

The interaction between cropping systems and genotypes with respect to commercial cane sugars was significant (Appendix XXXIV) during both the years. The data (Table 22a and Fig. 14) revealed that during 1998-2000, under autumn sugarcane intercropped with mustard crop sequences, CoPant 93227 recorded significantly higher commercial cane sugar than that of CoPant 90223 and CoPant 92226. However, under mustard – spring sugarcane and wheat – late spring sugarcane crop sequences, CoPant 90223 recorded significantly higher commercial cane sugar, than that of CoPant 92226 but at par with CoPant 93227. Similar trend was noted during 1999-2001.

4.2.14 Juice pH

The differences in juice pH due to cropping systems and genotypes were significant during 1999-2001 (Table 23 and Appendix XXXV & XXXVI). Juice pH trended to increase from December to February during both the years. Autumn sugarcane intercropped with mustard exhibited significantly higher juice pH than that of spring and late spring sugarcane. The differences in juice pH under spring and late spring planted sugarcane crops were not significant at all the stages except in January in 1999-2001.

Among genotypes, CoPant 90223 exhibited significantly higher juice pH than that of CoPant 92226 and CoPant 93227 at all the stages. The differences in juice pH in CoPant 92226 and CoPant 93227 were not significant at all the stages except in January.

Fertilizer levels significantly affected juice pH during both the years. At harvesting (March), crop fertilized with 125 per cent of the recommended NPK recorded significantly higher juice pH than that of 75 per cent of the recommended NPK, during both the years. The differences in juice pH under 75 and 100 per cent of the recommended NPK and 100 and 125 per cent of the recommended NPK were not significant. Similar trend was noted at other stages. The interactions among cropping systems genotypes and fertilizer levels in relation to juice pH were not significant during both the years.

4.3 Nutrients content in different plant parts

4.3.1 Nitrogen content in cane

Data on nitrogen content in cane at harvest (Table 24 and Appendix XXXVII & XXXVIII) revealed that significantly higher nitrogen content (0.580 and 0.761 per cent) was recorded in autumn planted sugarcane intercropped with mustard than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat during both the years. Late spring sugarcane exhibited minimum cane nitrogen content of 0.462 and 0.448 per cent being significantly lower than that of spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variation with respect to nitrogen content in cane was also significant during both the crop seasons. Genotypes, CoPant 92226 exhibited significantly higher nitrogen content (0.563 and 0.548 per cent), than that of CoPant 90223 and CoPant 93227 during both the seasons. Variations in nitrogen

Table24: Nitrogen content (%) in cane, top and trash at harvest under different treatments

Treatment	Nitrogen per cent					
	1998-2000			1999-2001		
	Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems						
Autumn Sugarcane + Mustard (Divya)	0.580	0.778	0.591	0.563	0.761	0.569
Mustard (PR-15) - Spring Sugarcane	0.509	0.740	0.523	0.495	0.727	0.503
Wheat (UP 2338) - Late Spring Sugarcane	0.462	0.688	0.478	0.448	0.672	0.459
SEm±	0.006	0.007	0.003	0.007	0.005	0.005
CD at 5%	0.019	0.022	0.009	0.022	0.015	0.017
Genotypes						
Co Pant 90223	0.501	0.739	0.516	0.484	0.723	0.494
Co Pant 92226	0.563	0.758	0.574	0.548	0.745	0.554
Co Pant 93227	0.488	0.709	0.502	0.473	0.694	0.484
SEm±	0.006	0.007	0.003	0.007	0.005	0.005
CD at 5%	0.019	0.022	0.009	0.022	0.015	0.017
Fertilizer levels (% of recommended NPK)						
75	0.471	0.700	0.485	0.454	0.683	0.462
100	0.521	0.736	0.531	0.506	0.721	0.513
125	0.561	0.771	0.577	0.545	0.756	0.557
SEm±	0.007	0.008	0.005	0.008	0.004	0.004
CD at 5%	0.022	0.023	0.015	0.025	0.013	0.013

content in CoPant 90223 and CoPant 93227 were also significant in 1998-2000, where former contained more nitrogen (0.501 per cent) than later (0.488 per cent).

Nitrogen content in cane differed significantly owing to fertilizer (NPK) levels during both the crop seasons. Crop fertilized with 125 per cent of the recommended NPK recorded maximum nitrogen per cent of 0.561 and 0.545 per cent respectively, being significantly higher than that of the 75 and 100 per cent of recommended NPK during both the years. The differences in nitrogen content in the crop receiving 75 and 100 per cent of recommended NPK were also significant where former exhibited more can nitrogen (0.471 and 0.683 per cent) than later (0.561 and 0.545 per cent) during two crop seasons, respectively. None of the interactions were significant during both the years.

4.3.2 Nitrogen in green top

The data on nitrogen content in green top at harvest (Table 24 and Appendix XXXVII & XXXVIII) exhibited that autumn sugarcane intercropped with mustard accumulated significantly higher nitrogen (0.778 and 0.761 per cent) than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop during two crop seasons. Late spring sugarcane planted after wheat exhibited minimum nitrogen content of 0.688 and 0.672 per cent being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

The genotypes, CoPant 92226 accumulated maximum nitrogen (0.758 and 0.745 per cent), being significantly higher than that of CoPant 90223 and CoPant 93227 during both the years. Variations in nitrogen content in CoPant 90223 and CoPant 93227 were also significant where former accumulated more nitrogen (0.739 and 0.723 per cent) than later (0.709 and 0.694 per cent) during two years, respectively.

Nitrogen content in green top varied significantly due to NPK levels during both the years. Crop fertilized with 125 per cent of the recommended NPK levels contained maximum nitrogen content of 0.771 and 0.756 per cent, being significantly higher than that of crop fertilized with 75 and 100 per cent of recommended NPK levels during 1998-2000 and 1999-2001, respectively. The differences in nitrogen content in the crop receiving 100 and 125 per cent of the recommended NPK were, however, not significant. Interactions were not significant during both the years.

4.3.3 Nitrogen content in trash

Variations in nitrogen content in trash due to cropping systems, genotypes and NPK levels were significant (Appendix XXXVII & XXXVIII). The data (Table 24) indicated that autumn seasons planted sugarcane + mustard intercrop recorded significantly higher nitrogen (0.591 and 0.569 per cent, respectively) than spring sugarcane planted after mustard and later spring sugarcane planted after wheat crop during both the years. Late spring planted sugarcane accumulated minimum nitrogen content of 0.478 and 0.459 per cent, being

significantly lower than 0.523 and 0.503 per cent under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotype, CoPant 92226 contained significantly higher nitrogen (0.574 and 0.554 per cent) than that of CoPant 90223 and CoPant 93227 during 1998-2000 and 1999-2001, respectively. Differences in nitrogen content in trash between CoPant 90223 and CoPant 93227 were significant during 1998-2000 where former recorded more nitrogen (0.516 per cent) than later (0.502 per cent). Genotype CoPant 93227 recorded minimum nitrogen content of 0.502 and 0.484 per cent, being significantly lower than that of CoPant 92226 during both the years, respectively.

Crop fertilized with 125 per cent of the recommended NPK accumulated significantly higher nitrogen (0.577 and 0.577 per cent) than that of 75 and 100 per cent of NPK during both the years, respectively. The differences in trash nitrogen between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower nitrogen (0.485 and 0.462 per cent) than later (0.531 and 0.513 per cent) during both the years, respectively. None of the interactions were significant during two crop seasons.

4.3.4 Phosphorus content in cane

Variations in phosphorus content in cane at harvest due to different treatments were significant during 1999-2001. Data (Table 25) showed that autumn sugarcane intercropped with mustard accumulated significantly higher

Table 25: Phosphorus content (%) in cane, top and trash at harvest under different treatments

Treatment	Phosphorus per cent					
	1998-2000			1999-2001		
	Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems						
Autumn Sugarcane + Mustard (Divya)	0.090	0.090	0.076	0.065	0.086	0.097
Mustard (PR-15) - Spring Sugarcane	0.086	0.084	0.070	0.059	0.080	0.068
Wheat (UP 2338) - Late Spring Sugarcane	0.058	0.079	0.066	0.054	0.076	0.062
SEm±	0.019	0.0014	0.0018	0.0002	0.0003	0.013
CD at 5%	NS	0.0043	0.0055	0.0008	0.0009	NS
Genotypes						
Co Pant 90223	0.087	0.085	0.070	0.059	0.080	0.067
Co Pant 92226	0.066	0.090	0.075	0.063	0.086	0.095
Co Pant 93227	0.081	0.079	0.068	0.055	0.076	0.065
SEm±	0.019	0.0014	0.0018	0.0002	0.0003	0.013
CD at 5%	NS	0.0043	NS	0.0008	0.0009	NS
Fertilizer levels (% of recommended NPK)						
75	0.059	0.079	0.067	0.055	0.076	0.063
100	0.063	0.085	0.071	0.059	0.081	0.071
125	0.111	0.090	0.075	0.063	0.086	0.092
SEm±	0.018	0.0005	0.0004	0.0003	0.0002	0.014
CD at 5%	NS	0.0015	0.0012	0.0008	0.0007	NS

phosphorus (0.065 per cent) and than spring (0.059 per cent) and late spring (0.054 per cent) planted crops.

Genotype, CoPant 92226 recorded maximum phosphorus (0.063 per cent), being significantly higher than CoPant (0.055 per cent) but at par with CoPant 90223 during 1999-2001. Minimum phosphorus content was recorded in CoPant 93227 (0.055 per cent), being significantly lower than that of CoPant 92226 and at par with CoPant 90223.

Crop fertilized with 125 per cent of recommended NPK exhibited maximum phosphorus content (0.063 per cent), being significantly higher than that of 75 and 100 per cent of recommended NPK. Crop receiving 75 per cent of the recommended NPK recorded minimum phosphorus (0.055 per cent), being significantly lower than that of 100 and 125 per cent of the recommended NPK during 1999-2001.

4.3.5 Phosphorus content in green top

Differences in phosphorus content in green top due to cropping systems, genotypes and fertilizer levels were significant (Appendix XXXIX & XL). The data (Table 25) showed that autumn planted sugarcane intercropped with mustard contained significantly higher phosphorus (0.090 and 0.086 per cent) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years except during 1999-2001, where differences in phosphorus content in green top in autumn and spring season planted sugarcane crops were not significant. Late spring sugarcane accumulated

minimum phosphorus content of 0.079 and 0.076 per cent, being significantly lower than that of spring and autumn sugarcane during both the years except during 1999-2001 in spring sugarcane.

Genotypic variations with respect to phosphorus content in green top were significant during both the years. Genotype, CoPant 92226 accumulated more phosphorus (0.090 and 0.086 per cent) than CoPant 90223 and CoPant 93227 during both the years except during 1999-2001, where differences in phosphorus content in CoPant 90223 and CoPant 92226 were not significant. The differences in phosphorus content in CoPant 92226 and CoPant 93227 were also significant where former contained more phosphorus in green top (0.090 and 0.086 per cent) than later (0.079 and 0.076 per cent) during both the years, respectively.

Variations in phosphorus content in green top due to fertilizer levels indicated that crop fertilized with 125 per cent of the recommended NPK recorded maximum phosphorus of 0.090 and 0.086 per cent, being significantly higher than that of crop receiving 75 and 100 per cent of the recommended NPK during both the years, respectively. The differences in phosphorus content in the crop fertilized with 100 and 125 per cent of the recommended NPK were also significant where former accumulated more phosphorus (0.090 and 0.086 per cent) than later (0.085 and 0.081 per cent), during both the years, None of the interactions were significant during both the years.

4.3.6 Phosphorus content in trash

The variations in phosphorus content due to cropping systems, genotypes and fertilizer levels were not significant during 1999-2001 (Appendix XXXIX & XL). However, during 1998-2000 differences in phosphorus content due to cropping systems and fertilizer levels were significant. The data (Table 25) revealed that autumn planted sugarcane intercropped with mustard recorded significantly higher phosphorus (0.076 per cent) than that of spring sugarcane planted after mustard (0.070 per cent) and late spring sugarcane planted after wheat (0.066 per cent) during 1998-2000. The differences in phosphorus content in trash under spring and late spring planted sugarcane were also significant where as later exhibited lower phosphorus (0.066 per cent) than former (0.070 per cent).

Crop fertilized with 125 per cent of the recommended NPK contained significantly higher phosphorus in trash than that of 75 and 100 per cent of the recommended NPK levels during 1998-2000.

The phosphorus content in trash under 75 and 100 per cent of the recommended NPK levels were also significant where later exhibited more phosphorus content (0.071 per cent) than former (0.067 per cent) during 1998-2000. Interactions were not significant in any of the years.

4.3.7 Potassium content in cane

The data on potassium content in cane (Table 26 and Appendix XLI & XLII) revealed that autumn sugarcane intercropped with mustard contained

Table26: Potassium content (%) in cane, top and trash at harvest under different treatments

Treatment		Potassium per cent					
		1998-2000			1999-2001		
		Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems							
Autumn Sugarcane + Mustard (Divya)		0.781	0.997	0.601	0.759	0.977	0.580
Mustard (PR-15) - Spring Sugarcane		0.743	0.962	0.579	0.724	0.905	0.559
Wheat (UP 2338) - Late Spring Sugarcane		0.713	0.936	0.552	0.694	0.917	0.534
SEm±		0.0073	0.010	0.007	0.0016	0.022	0.0018
CD at 5%		0.0219	0.032	0.021	0.0050	0.066	0.0056
Genotypes							
Co Pant 90223		0.747	0.926	0.561	0.726	0.907	0.543
Co Pant 92226		0.769	1.064	0.613	0.748	1.007	0.593
Co Pant 93227		0.721	0.906	0.558	0.703	0.886	0.537
SEm±		0.0073	0.010	0.007	0.0016	0.022	0.0018
CD at 5%		0.00219	0.032	0.021	0.0050	0.066	0.0056
Fertilizer levels (% of recommended NPK)							
75		0.721	0.885	0.538	0.700	0.864	0.518
100		0.741	0.969	0.587	0.722	0.949	0.566
125		0.775	1.042	0.608	0.756	0.985	0.589
SEm±		0.0073	0.011	0.006	0.0037	0.020	0.0021
CD at 5%		0.0210	0.033	0.018	0.0107	0.059	0.0062

significantly higher potassium (0.781 and 0.759 per cent) than that of spring sugarcane and late spring sugarcane during both the crop seasons. Late spring sugarcane planted after wheat exhibited minimum potassium content of 0.713 and 0.694 per cent, being significantly lower than autumn sugarcane and spring sugarcane during both the years, respectively.

Genotype, CoPant 92226 accumulated significantly more potassium (0.769 and 0.748 per cent) than that of CoPant 90223 and CoPant 93227 during 1998-2000 and 1999-2001, respectively. Variations in potassium content in cane in CoPant 93227 and CoPant 90223 were also significantly where former accumulated less potassium (0.721 and 0.703 per cent) than later (0.747 and 0.726 per cent) during both the years, respectively.

Increasing fertilizer levels from 75 to 125 per cent of the recommended NPK improved potassium content in cane during both the years. Crop receiving 125 per cent of the recommended NPK contained more potassium in cane than that of 75 and 100 per cent of the recommended NPK levels. The differences in potassium containing in crop receiving 75 and 100 per cent of the recommended NPK were significant during 1999-2001, where former exhibited less potassium content (0.721 and 0.700 per cent) than later (0.741 and 0.722 per cent). None of the interactions were significant during both the years.

4.3.8 Potassium content in green top

Data (Table 26 and Appendix XLI & XLII) revealed that variations in potassium content in green top due to different treatments were significant

during both the years. Autumn planted sugarcane crop contained significantly higher potassium (0.997 and 0.977 per cent) than that of spring sugarcane following mustard and late spring sugarcane followed wheat crop. The variations in potassium content in green top under late spring and spring sugarcane crops were also significant where former exhibited less potassium (0.936 and 0.917 per cent) than later (0.962 and 0.905 per cent) during both the years, respectively.

Genotypes, CoPant 92226 and CoPant 90223, being at par exhibited significantly higher potassium content than CoPant 93227 during both the years. Crop receiving 125 per cent of the recommended NPK contained significantly higher potassium content than that of 75 and 100 per cent of the recommended NPK. Crop fertilized with 75 per cent of recommended NPK recorded minimum potassium content of 0.885 and 0.864 per cent, being significantly lower than that of 100 and 125 per cent of the recommended NPK during both the years, respectively. Interactions were not significant during both the years.

4.3.9 Potassium content in trash

The data on potassium content in trash (Table 26 and Appendix XLI & XLII) revealed that autumn sugarcane intercropped with mustard contained significantly higher potassium (0.601 and 0.580 per cent) than that of spring planted sugarcane after mustard and later spring planted sugarcane after wheat. The differences in potassium content in spring and late spring sugarcane crops were also significant, where later contained less potassium (0.552 and 0.534 per cent) than former (0.579 and 0.559 per cent) during both the years.

CoPant 92226 attained significantly higher (0.613 and 0.593 per cent, respectively) during both the years. However, differences in potassium content between CoPant 92226 and CoPant 93227 were not significant.

Fertilizer levels brought significant variations in potassium content in trash. Crop fertilized with 125 per cent of the recommended NPK accumulated significantly higher potassium than that of 75 and 100 per cent of NPK during two seasons. The differences in potassium content at 75 and 100 per cent of the recommended NPK levels were also significant where former accumulated less potassium than later.

The interactions between cropping systems, genotypes and fertilizer levels for potassium content were not significant during 1998-2000. During 1999-2001, though interactions were significant but did not show any definite trend.

4.4 Nutrient uptake

4.4.1 Nitrogen uptake by cane

Variations in nitrogen uptake due to cropping systems, genotypes and fertilizer levels were significant (Appendix XLIII). Data (Table 27) indicated that autumn season planted sugarcane intercropped with mustard removed significantly higher nitrogen (224.5 and 214.7 kg ha⁻¹) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years. Late spring season planted sugarcane removed minimum nitrogen of 139.3 and 163.7 kg ha⁻¹, being significantly lower than 174.5 and

Table 27: Effect of cropping systems, genotypes and fertilizer levels on nitrogen uptake (kg ha^{-1}) in different plant parts

Treatment		Nitrogen uptake (kg ha^{-1})					
		1998-2000			1999-2001		
		Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems							
Autumn Sugarcane + Mustard (Divya)		224.5	29.2	48.8	214.7	25.7	43.3
Mustard (PR-15) - Spring Sugarcane		174.5	24.4	38.5	165.1	21.2	34.0
Wheat (UP 2338) - Late Spring Sugarcane		139.3	19.5	31.0	132.7	17.0	27.2
SEm $\pm$		0.57	0.06	0.07	0.28	0.02	0.05
CD at 5%		1.72	0.19	0.22	0.85	0.07	0.14
Genotypes							
Co Pant 90223		172.3	24.2	37.8	163.6	21.1	33.2
Co Pant 92226		203.9	26.4	46.0	194.3	23.1	41.0
Co Pant 93227		162.2	22.5	34.6	154.5	19.7	30.3
SEm $\pm$		0.57	0.06	0.07	0.28	0.02	0.05
CD at 5%		1.72	0.19	0.22	0.85	0.07	0.14
Fertilizer levels (% of recommended NPK)							
75		158.7	22.2	33.7	150.3	19.3	29.2
100		180.3	24.4	39.4	171.4	21.4	34.9
125		199.4	26.6	45.4	190.7	23.3	40.5
SEm $\pm$		0.28	0.04	0.05	0.30	0.02	0.04
CD at 5%		0.83	0.12	0.17	0.88	0.05	0.11

165.1 kg ha⁻¹ under spring sugarcane during 1998-2000 and 1999-2001 respectively.

Genotypic variations with respect to nitrogen uptake were also significant during both the years. Genotype CoPant 92226 removed significantly higher nitrogen (203.9 and 194.3 kg ha⁻¹) than CoPant 90223 (172.3 and 163.6 kg ha⁻¹) and CoPant 93227 (162.2 and 154.5 kg ha⁻¹) during both the years. Differences in nitrogen uptake in CoPant 90223 and CoPant 93227 were also significant during both the years. The minimum nitrogen uptake of (162.2 and 154.5 kg ha⁻¹) was recorded with CoPant 93227, being significantly lower than that of CoPant 90223 during both the crop seasons, respectively.

Crop fertilized with 125 per cent of the recommended NPK removed significantly higher nitrogen (199.4 and 190.7 kg ha⁻¹) than that of 75 and 100 per cent of the recommended NPK during both the years. Differences in nitrogen uptake between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower nitrogen uptake (158.7 and 150.3 kg ha⁻¹) than later (180.3 and 171.4 kg ha⁻¹) during both the crop seasons, respectively.

4.4.2 Nitrogen uptake by green top

Variations in green top uptake of nitrogen due to cropping systems, genotypes and fertilizer levels were significant (Appendix XLIII). Data (Table 27) indicated that autumn season planted sugarcane intercropped with mustard removed significantly higher nitrogen in green top (29.2 and 25.7 kg ha⁻¹) than

that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the crop seasons. Late spring sugarcane gave minimum nitrogen uptake of 19.5 and 17.0 kg ha⁻¹, being significantly lower than 24.4 and 21.2 kg ha⁻¹ under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to nitrogen uptake in green top were significant during both the crop seasons. Genotype CoPant 92226 removed significantly more nitrogen in (26.4 and 23.1 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during both the years. Differences in nitrogen uptake in green top in CoPant 90223 and CoPant 93227 were also significant during both the years where former removed more nitrogen than later.

Nitrogen uptake in green top also differed significantly due to NPK levels during both the years. Crop fertilized with 125 per cent of recommended NPK recorded maximum nitrogen uptake of 26.6 and 23.3 kg ha⁻¹, being significantly higher than that of 75 and 100 per cent of the recommended NPK during 1998-2000 and 1999-2001, respectively. The differences in nitrogen uptake in green top under 75 and 100 per cent of the recommended NPK were significant where former exhibited lower uptake of nitrogen (22.2 and 19.3 kg ha⁻¹) than later (24.4 and 21.4 kg ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.4.3 Nitrogen uptake by trash

Variations in trash nitrogen uptake due to cropping systems, genotypes and fertilizer levels were significant (Appendix XLIII). Data (Table 27) indicated

that autumn season planted sugarcane with mustard inter crop removed significantly higher nitrogen uptake (48.8 and 43.3 kg ha^{-1} , respectively) than spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years. Late spring sugarcane removed minimum nitrogen of 31.0 and 27.2 kg ha^{-1} , being significantly lower than 38.5 and 34.0 kg ha^{-1} under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to nitrogen removal in trash were significant during both the years. CoPant 92226 exhibited significantly higher nitrogen (46.0 and 41.0 kg ha^{-1}) than that of CoPant 90223 and CoPant 93227 during both the years. The differences in nitrogen uptake in trash in CoPant 90223 and CoPant 93227 were also significant where former exhibited more nitrogen uptake (37.8 and 33.2 kg ha^{-1}) than later (34.6 and 30.3 kg ha^{-1}).

Crop fertilized with 125 per cent of the recommended NPK removed significantly higher nitrogen (45.4 and 40.5 g ha^{-1}) than that of 75 and 100 per cent of the recommended NPK during both the years. Differences in nitrogen uptake in trash between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower nitrogen uptake (33.7 and 29.2 kg ha^{-1}) than later (45.4 and 40.5 kg ha^{-1}) during two crop seasons, respectively.

4.4.4 Phosphorus uptake by cane

The data uptake (Table 28 and Appendix XLIV) revealed that significantly higher phosphorus uptake in cane (24.7 and 35.6 kg ha^{-1}) was recorded under autumn sugarcane intercropped with mustard than that of spring

Table 28: Effect of cropping systems, genotypes and fertilizer levels on phosphorus uptake (kg ha^{-1}) in different plant parts

Treatment	Phosphorus uptake (kg ha^{-1})					
	1998-2000			1999-2001		
	Cane	Green top	Trash	Cane	Green top	Trash
Cropping systems						
Autumn Sugarcane + Mustard (Divya)	24.7	3.0	7.4	25.6	3.4	6.2
Mustard (PR-15) - Spring Sugarcane	19.8	2.4	4.5	21.5	2.8	5.1
Wheat (UP 2338) - Late Spring Sugarcane	16.2	1.9	3.7	17.5	2.3	4.3
SEm $\pm$	0.016	0.002	0.11	0.58	0.008	0.011
CD at 5%	0.050	0.007	0.35	1.60	0.024	0.035
Genotypes						
Co Pant 90223	20.1	2.4	4.5	21.8	2.8	5.0
Co Pant 92226	22.4	2.7	7.1	23.8	3.1	5.9
Co Pant 93227	18.3	2.2	4.1	18.9	2.5	4.6
SEm $\pm$	0.016	0.002	0.11	0.53	0.008	0.011
CD at 5%	0.050	0.007	0.35	1.60	0.024	0.035
Fertilizer levels (% of recommended NPK)						
75	18.5	2.1	4.0	20.0	2.5	4.6
100	20.2	2.4	5.1	21.7	2.8	5.2
125	22.0	2.6	6.5	22.8	3.1	5.8
SEm $\pm$	0.015	0.001	0.10	0.54	0.003	0.005
CD at 5%	0.044	0.004	0.32	1.52	0.009	0.016

sugarcane planted after mustard and late spring sugarcane planted after wheat crop. Late spring sugarcane planted after wheat exhibited minimum phosphorus uptake in cane (16.2 and 17.5 kg ha⁻¹), being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to phosphorus uptake in cane were significant during both the crop seasons. Genotype, CoPant 92226 exhibited significantly more phosphorus uptake in cane (22.4 and 23.8 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during both the crop seasons. Variations in phosphorus uptake in CoPant 90223 and CoPant 93227 with respect to phosphorus uptake by cane were also significant during both the years.

Phosphorus uptake in cane varied significantly due to fertilizer levels during both the crop seasons. Crop fertilized with 125 per cent of the recommended NPK removed maximum phosphorus of 22.0 and 32.8 kg ha⁻¹, being significantly higher than that of 75 and 100 per cent of the recommended NPK during 1998-2000 and 1999-2001, respectively. The differences in cane phosphorus uptake by cane under 75 and 100 per cent of recommended NPK were also significant where former exhibited lower phosphorus uptake (18.5 and 20.0 kg ha⁻¹) than later (20.2 and 21.7 kg ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.4.5 Phosphorus uptake by green top

Variations in phosphorus uptake in green top due to cropping systems, genotypes and fertilizer levels were significant (Appendix XLIV). Data (Table 28) indicated that autumn season planted sugarcane intercropped with mustard exhibited significantly higher phosphorus uptake (3.0 and 3.4 kg ha^{-1}) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years. Late spring season planted sugarcane gave minimum phosphorus uptake of 1.9 and 2.3 kg ha^{-1} , being significantly lower than 2.4 and 2.8 kg ha^{-1} under spring sugarcane during 1998-2000 and 1999-2001, respectively.

Genotypic variation with respect to phosphorus uptake was significant during both the years. CoPant 92226 exhibited significantly higher phosphorus uptake (2.7 and 3.1 kg ha^{-1}) than that of CoPant 90223 and CoPant 93227, respectively. Differences in phosphorus uptake in green top in CoPant 90223 and CoPant 93227 were also significant during 1998-2000 and 1999-2001. However, minimum phosphorus uptake was recorded in genotype CoPant 93227 (2.2 and 2.5 kg ha^{-1}), being significantly lower than that of CoPant 90223 and CoPant 92226.

Crop fertilized with 125 per cent of the recommended NPK removed significantly higher phosphorus in green top (2.6 and 3.1 kg ha^{-1}) than that of 75 and 100 per cent of the recommended NPK during both the years. Differences in phosphorus uptake between 75 and 100 per cent of the recommended NPK were

also significant where former exhibited lower phosphorus uptake in green top (2.1 and 2.5 kg ha⁻¹) than that of later (2.4 and 2.8 kg ha⁻¹) during 1998-2000 and 1999-2001, respectively.

4.4.6 Phosphorus uptake by trash

Data (Table 28 and Appendix XLIV) indicated that significantly higher phosphorus uptake of 7.4 and 6.2 kg ha⁻¹ in trash was noted in autumn season sugarcane intercropped with mustard than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop sequences during two years, respectively. Late spring sugarcane planted after wheat harvesting removed minimum trash phosphorus of 3.7 and 4.3 kg ha⁻¹, being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to trash phosphorus were significant during both the crop seasons. Genotype CoPant 92226 removed significantly more phosphorus in trash (7.1 and 5.9 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during both the years. The differences in trash yield in CoPant 90223 and CoPant 93227 were significant during both the years.

Trash phosphorus uptake differed significantly due to NPK levels during both the years. Crop fertilized with 125 per cent of the recommended NPK removed maximum trash phosphorus uptake of 6.5 and 5.8 kg ha⁻¹, being significantly higher than that of 75 and 10 per cent of the recommended NPK levels during 1998-2000 and 1999-2001, respectively. The differences in

phosphorus uptake under 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower phosphorus uptake (4.0 and 4.6 kg ha⁻¹) than later (5.1 and 5.2 kg ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.4.7 Potassium uptake in cane

The data (Table 29 and Appendix XLV) revealed that significantly higher potassium in cane (298.4 and 290.0 kg ha⁻¹) was recorded intercropped with mustard than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop sequences. Late spring sugarcane planted after wheat exhibited minimum potassium uptake in cane (215.6 and 206.2 kg ha⁻¹), being significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to uptake of potassium by cane were significant during both the seasons. Genotype CoPant 92226 exhibited significantly higher potassium (272.7 and 264.7 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during both the crop seasons. Variations in potassium uptake in cane in CoPant 90223 and CoPant 93227 were also significant where former removed more potassium than later during both the crop seasons.

Potassium uptake by cane also varied significantly due to fertilizer levels. Crop fertilized with 125 per cent of the recommended NPK removed maximum potassium of 270.2 and 263.4 kg ha⁻¹, being significantly higher than that of 75 and 100 per cent of the recommended NPK during 1998-2000 and 1999-2001,

Table 29: Effect of cropping systems, genotypes and fertilizer levels on potassium uptake (kg ha^{-1}) in different plant parts

Treatment		Potassium uptake (kg ha^{-1})					
		1998-2000			1999-2001		
Cropping systems		Cane	Green top	Trash	Cane	Green top	Trash
Autumn Sugarcane + Mustard (Divya)		298.4	37.5	48.7	290.0	33.1	44.2
Mustard (PR-15) - Spring Sugarcane		253.9	31.8	41.7	242.2	26.5	37.8
Wheat (UP 2338) - Late Spring Sugarcane		215.6	26.6	35.1	206.2	23.2	31.7
SEm±		8.1	0.8	0.8	1.3	0.07	0.28
CD at 5%		24.3	2.5	2.6	4.1	0.21	0.09
Genotypes							
Co Pant 90223		256.3	30.2	40.1	244.9	26.5	36.4
Co Pant 92226		272.7	37.0	48.1	264.7	31.3	43.8
Co Pant 93227		239.0	28.5	37.4	228.8	25.0	33.4
SEm±		8.13	0.8	0.8	1.3	0.07	0.3
CD at 5%		24.3	2.5	0.26	4.1	0.21	0.9
Fertilizer levels (% of recommended NPK)							
75		242.3	27.9	36.3	230.7	24.4	32.6
100		255.3	32.0	42.6	244.4	28.2	38.4
125		270.2	35.9	46.7	263.4	30.3	42.7
SEm±		2.8	0.5	0.5	1.7	0.06	0.35
CD at 5%		8.4	1.7	1.6	1.72	0.21	1.00

respectively. Differences in potassium uptake in cane under 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower potassium (242.3 and 230.7 kg ha⁻¹) than later (255.3 and 244.4 kg ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.4.8 Potassium uptake by green top

Variations in potassium uptake in green top due to cropping systems, genotypes and fertilizer levels were significant (Appendix XLV). Data (Table 29) indicated that autumn season planted sugarcane intercropped with mustard exhibited significantly higher potassium uptake in green top (37.5 and 33.1 kg ha⁻¹) than that of spring sugarcane planted after mustard and late spring sugarcane following wheat crop during both the years. Late spring season planted sugarcane gave minimum potassium, uptake of 26.6 and 23.2 kg ha⁻¹, being significantly lower than 31.8 and 26.5 kg ha⁻¹ under spring sugarcane during 198-2000 and 1999-2001, respectively.

Genotypic variation with respect to potassium uptake in green top were significant during both the years CoPant 92226 exhibited significantly higher potassium uptake in green top (37.0 and 31.3 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during 1998-2000 and 1999-2001, respectively. The differences in potassium in CoPant 90223 and CoPant 93227 were also significant during both the years.

Crop fertilized with 125 per cent of the recommended NPK contained significantly higher uptake of potassium in green top (35.9 and 30.3 kg ha⁻¹) than

that of 75 and 100 per cent of the recommended NPK levels during both the years. Differences in potassium uptake between 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower potassium uptake (27.9 and 24.4 kg ha⁻¹) than later (32.0 and 28.2 kg ha⁻¹) during both the years, respectively.

4.4.9 Potassium uptake by trash

Data on (Table 29 and Appendix XLV) revealed significantly higher potassium uptake in trash (48.7 and 44.2 kg ha⁻¹) under autumn sugarcane inter cropped with mustard than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop sequences during two years. Late spring sugarcane planted after wheat harvesting removed minimum potassium uptake of 35.1 and 23.2 kg ha⁻¹ significantly lower than that of spring sugarcane following mustard during 1998-2000 and 1999-2001, respectively.

Genotypic variations with respect to potassium uptake in trash were significant during both the crop seasons. Genotype CoPant 92226 removed significantly more trash potassium (48.1 and 31.3 kg ha⁻¹) than that of CoPant 90223 and CoPant 93227 during both the years. Differences in trash potassium uptake in CoPant 90223 and CoPant 93227 were also significant during both the years.

Potassium uptake in trash also differed due to fertilizer levels during both the years. Crop fertilized with 125 per cent of the recommended NPK recorded maximum potassium in trash of 46.7 and 42.7 kg ha⁻¹, being significantly higher

than that of 75 and 100 per cent of the recommended NPK during 1998-2000 and 1999-2001, respectively. The differences in potassium uptake in trash under 75 and 100 per cent of the recommended NPK were also significant where former exhibited lower potassium uptake (36.3 and 32.6 kg ha⁻¹) than later (42.6 and 38.4 kg ha⁻¹), during 1998-2000 and 1999-2001, respectively.

4.5 Residual soil fertilizer at harvest

The data appertaining to residual soil fertilizer after harvest of crop are presented in Table 30 and their analysis of variance in Appendix XLIV and are described here under :

4.5.1 Available soil nitrogen

Data (Table 30) pertinent to available soil nitrogen analyzed at harvest of plant crop showed that autumn sugarcane intercropped with mustard recorded its superiority over the mustard spring and wheat-late spring sugarcane, cropping system. However, differences between mustard spring and wheat late spring sugarcane were significant during both the years. Whereas minimum nitrogen was under wheat-late spring sugarcane being significantly lower than autumn + mustard and spring sugarcane planted after mustard.

Among the genotypes, CoPant 92226 recorded significantly higher available nitrogen than that of CoPant 90223 and CoPant 93227 during both the years. However, minimum nitrogen (170.0 and 183.6 kg ha⁻¹) was recorded in CoPant 93227, being significantly lower than CoPant 92223 (184.1 and 189.4 kg ha⁻¹) and CoPant 92226 (193.0 and 198.6 kg ha⁻¹) during both the years.

Table 30: Effect of cropping systems, genotypes and fertilizer levels on residual soil nitrogen, phosphorus and potassium (kg ha⁻¹)

Treatment	Available nutrients at harvest (kg ha ⁻¹)			
	1998-2000		1999-2001	
Cropping systems	Nitrogen	Phosphorus	Potassium	
Autumn Sugarcane + Mustard (Divya)	189.3	18.6	207.4	Potassium
Mustard (PR-15) - Spring Sugarcane	185.4	17.3	201.0	Phosphorus
Wheat (UP 2338) - Late Spring Sugarcane	180.4	16.1	194.5	Nitrogen
SEm±	1.6	0.3	1.5	Potassium
CD at 5%	4.8	1.0	4.7	Phosphorus
Genotypes				Potassium
Co Pant 90223	184.1	17.0	198.5	189.4
Co Pant 92226	193.0	18.6	211.7	198.6
Co Pant 93227	178.0	16.4	192.7	183.6
SEm±	1.6	0.3	1.5	1.2
CD at 5%	4.8	1.0	4.7	0.3
Fertilizer levels (% of recommended NPK)				0.9
75	177.4	14.6	193.9	183.0
100	185.6	17.2	200.9	191.2
125	192.1	20.3	208.0	197.4
SEm±	2.3	0.4	2.7	2.3
CD at 5%	6.8	1.3	7.8	6.7

Variations in available nitrogen in soil after harvest of crop due to fertilizer levels were significant at all the levels during both the years. Crop fertilized with 125 per cent of the recommended fertilizer levels recorded maximum nitrogen (192.1 and 197.4 kg ha⁻¹) being significantly higher than 75 and 100 per cent of the recommended fertilizer levels during 1998-2000 and 1999-2001. Differences in available nitrogen in 75 to 100 per cent of the recommended fertilizer levels were also significant where former recorded lower (177.4 and 183.0 kg ha⁻¹) nitrogen than later (185.6 and 191.2 kg ha⁻¹).

4.5.2 Available soil phosphorus

The data presented in Table 30 and Appendix XLIV indicated that differences in available phosphorus due to cropping system, genotypes and fertilizer levels were significant during both the crop season.

The data on available phosphorus (Table 30 and Appendix XLIV) revealed that autumn sugarcane intercropped with mustard recorded available phosphorus of 18.6 and 20.6 kg ha⁻¹, being significantly higher than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop during two years, respectively. Differences in available phosphorus noted from spring and late spring sugarcane were also significant, when later recorded significantly lower available phosphorus (16.1 and 18.2 kg ha⁻¹) than former (17.3 and 19.3 kg ha⁻¹) during both the years, respectively.

Genotype CoPant 92226 recorded significantly higher available phosphorus (18.6 and 20.8 kg ha⁻¹) than CoPant 90223 (17.03 and 18.9 kg ha⁻¹)

and CoPant 93227 (16.4 and 18.4 kg ha⁻¹) during both the years. However, differences in CoPant 90223 and CoPant 93227 were also significant. Genotype CoPant 93227, recorded significantly lower available phosphorus (16.4 and 18.4 kg ha⁻¹) than rest of the genotypes during both the years.

Available phosphorus differed significant due to fertilizer levels during both the crop seasons. Crop fertilized with 125 per cent of the recommended fertilizer recorded maximum available phosphorus of 20.3 and 22.4 kg ha⁻¹, being significantly higher than that of 75 and 100 per cent of the recommended fertilizer levels during both the years, respectively. The differences in available phosphorus under 75 and 100 per cent of the recommended fertilizer levels were also significant where former recorded lower available phosphorus (14.6 and 16.5 kg ha⁻¹) than later (17.2 and 19.2 kg ha⁻¹), during both the years, respectively.

4.5.6 Available soil potassium

The data on available soil potassium (Table 30 and Appendix XLIV) revealed that autumn sugar intercropped with mustard recorded available potassium in soil of 207.4 and 211.5 kg ha⁻¹, being significantly higher than that of spring sugarcane planted after mustard and late spring sugarcane planted after wheat crop during both the years, respectively. Differences in available potassium recorded from spring and late spring sugarcane were also significant, where late recorded significantly lower available potassium (194.5 and 200.3 kg ha⁻¹) than former (201.0 and 206.4 kg ha⁻¹) during both the years, respectively.

Genotype CoPant 92226 recorded significantly higher available potassium (211.7 and 216.6 kg ha⁻¹) than CoPant 90223 (198.5 and 203.6 kg ha⁻¹) and CoPant 93227 (192.7 and 198.0 kg ha⁻¹) were significant. Genotype CoPant 93227, however, recorded significantly lower available potassium (192.7 and 198.0 kg ha⁻¹) than rest of the genotypes during both the years.

Available potassium in soil differed significantly due to fertilizer levels during both the years. Crop fertilized with 125 per cent of the recommended fertilizer levels recorded maximum available potassium in soil of 208.0 and 213.4 kg ha⁻¹, being significantly higher than that of 75 and 100 per cent of the recommended fertilizer levels during both the years, respectively. The differences in available potassium under 75 and 100 per cent of the recommended fertilizer levels were also significant where former exhibited lower available potassium (193.9 and 198.6 kg ha⁻¹) than late (200.9 and 206.3 kg ha⁻¹) during 1998-2000 and 1999-2001, respectively.



DISCUSSION

5. DISCUSSION

The experimental findings presented in the preceding chapter are discussed here in this chapter in order to establish cause and effect relationship. The investigation was carried out to study nutritional requirement of sugarcane genotypes under different cropping system.

The variations in crop growth and yield due to cropping systems are largely attributed to variations in the planting seasons. Spring season planted crop followed mustard exhibited significantly higher germination (49.8 and 47.7 per cent) than autumn sugarcane intercropped with mustard and late spring planting following wheat during both the years. Germination in autumn planted sugarcane was 17.7 and 15.3 per cent lower than that of spring sugarcane. The low germination in autumn season planted crop may be attributed to relatively lower temperature (19.7 and 18.3°C) available during the cause of germination. The late spring planted crop however, exhibited 29.1 and 37.5 per cent lower germination than that of spring sugarcane during two years, respectively. The lower germination under this crop may be attributed to limited soil moisture available as a result of higher environmental temperature (35.6 and 38.0°C) prevailing during the period of germination. Lower germination under autumn sugarcane than spring crop have also reported by Choudhary *et al.* (1996); Singh *et al.* (1999) and Hussain *et al.* (2000).

The differences in shoot population due to cropping system were significant during both the years. Autumn planted crop intercropped with mustard produced maximum shoot population of 133.1 and 155.1 thousand ha^{-1} at the peak tillering stage (June). Spring planted crop produced 40.3 and 25.5 per cent lower shoot population than autumn. The respective decline in late spring crop was 42.7 and 39.4 per cent over autumn season planted crop. Higher shoot population in autumn planted crop was due to larger period (150 days) of tillering. In spring and late spring season crop period of tillering was limited to 105 and 65 days, respectively. Mishra (1986), Rana *et al.* (1999) and Singh *et al.* (1999) also reported lower shoot population in late spring and spring planted crops than autumn sugarcane.

Autumn sugarcane intercropped with mustard further exhibited better crop growth in terms of shoot height and dry matter accumulation. Dry matter accumulation in autumn sugarcane was 31.7 and 49.9 per cent higher than spring and late spring crop sequences, respectively during 1998-2000. Respective value during 1999-2001 were 32.5 and 50.8 per cent. Dry matter accumulation per shoot is the function of LAI and duration of leaf and efficiency of leaf to convert radial energy in to chemical energy. Late spring planted crop exhibited significantly lower LAI than autumn and spring season crops at all the crop growth stages. The values of LAI in late spring planted crop at peak tillering stages (August) were 3.47 and 3.39 against 4.89 and 4.75 in autumn planted and 4.24 and 4.06 in spring planted crops during two crop seasons.

Varietal differences in relation to germination were significant. Genotype CoPant 93227 exhibited significantly higher germination than other genotypes indicating that CoPant 93227 was better germinator than CoPant 90223 and CoPant 92226. Higher germination in CoPant 93227 may be due to its inherent potential. Genotypic variations in relation to field emergence have also been reported by Saxena *et al.* (1982) and Mishra (1986). Genotype CoPant 93227 produced significantly higher shoot population than other genotypes at all the stages of crop growth. At peak tillering stage (August) CoPant 93227 produced 139.9 and 135.8 thousand ha^{-1} shoots, being significantly higher than other genotypes. Higher shoot population in this genotype may be due to its higher initial germination and profused tillering habit. Genotype CoPant 92226 accumulated maximum dry matter in different plant parts at all the stages of crop growth. During August, genotype CoPant 92226 accumulated 189.7 and 182.2 g/shoot dry matter, which was significantly higher than that of CoPant 90223 and CoPant 93227. The shoot height attained by CoPant 93227 was also higher than other genotypes at all the stages of crop growth. LAI varied with genotypes, maximum being in CoPant 92226 (4.32 and 4.15) followed by 90223 (4.23 and 4.05) and CoPant 93227 (4.05 and 4.00).

Cropping system and fertilizer interaction with respect to shoot height (Table 6a) revealed that fertilizer requirement of the crop varied with crop sequences/planting seasons. Autumn sugarcane + mustard intercrop exhibited significantly higher shoot height at 125 per cent of the recommended NPK,

whereas spring and late spring crop following mustard and wheat crop, respectively, exhibited statistically same plant height and 100 and 125 per cent of the recommended NPK. Similar findings also reported by Saini and Singh (1985) and Jayabal and Chockalingam (1990).

Fertilizer doses did not affect germination. However, shoot population varied owing to fertilizer doses. Crop fertilized with 125 per cent of the recommended NPK produced maximum shoot population of 138.4 and 133.7 thousand ha^{-1} , being 15.3 and 15.0 per cent more than 75 per cent of the recommended NPK (Table 5) during both the years. The shoot height also improved significantly due to increasing NPK levels. This was possible due to adequate availability of nutrients needed for better plant growth. Jayabal and Chockalingam (1990), Rahman *et al.* (1992) and Jamuna (1994) noted higher tillering population and crop growth at higher level of fertilizer.

Leaf area index generally represents measure of photosynthetic capacity of crop. Increasing application of fertilizer had beneficial effect of LAI at all the stages during both the years (Table 8 a&b). Higher LAI may be due to more tillers per unit area and more number of leaves per shoot. Adequate supply of NPK promotes elongation of apical meristem (Yadav and Prasad, 1987; Sekhar, 1985 and Mali *et al.*, 1983). Dry matter accumulation per shoot also increased with increasing fertilizer levels. Maximum dry matter per shoot (191.1 and 183.4 g/shoot) was accumulated under 125 per cent of the recommended fertilizer levels, being significantly higher than that of 100 (185.3 and 176.6 g/shoot) and

75 (181.2 and 173.3 g/shoot) per cent of recommended NPK levels during tow seasons. Higher dry matter accumulation at 125 per cent of the recommended NPK may be attributed higher LAI. Sharma and Gupta (1987) and Bhaujbal (1983) also noted higher dry matter accumulation at higher fertilizer levels.

The cane yield per unit area is function of number of millable canes and weight per cane. The number of millable canes in turn depends upon conversion ratio of shoot to millable canes. However, weight of individual cane is function of cane length and girth of cane. Autumn planted crop with mustard intercrop gave highest cane yield of 99.0 and 80.0 t ha⁻¹, being significantly higher than other planting season during two seasons planting of sugarcane in spring after mustard and late spring after wheat crop, decreased cane yield by 21.2 and 12.1 per cent and 44.2 and 35.1 per cent over autumn planted sugarcane during two years, respectively. The decreased cane yield under spring and late spring seasons was largely attributed to lower number of millable canes and lower individual cane weight. Late spring planted crop produced 43.9 and 22.5 and 20.1 and 15.5 thousand ha⁻¹ lower millable canes than that of autumn + mustard and mustard-spring planted sugarcane during both the years, respectively. Individual cane weight was also lower under late spring than spring (798 and 764 g) and autumn season sugarcane + mustard (828 and 821 g). The cane length was also lower under wheat-late spring cropping system. Late spring planted crop attained significantly lower cane length (236.0 and 186.2 cm) than spring (244.8 and 246.3 cm) and autumn (259.8 and 269.7 cm) planted sugarcane. The weight

of individual cane was 828 and 821 g in autumn + mustard against 798 and 764 g in mustard-spring and 740 and 678 g in wheat-late spring sugarcane. These results are in agreement with the findings of Bachloo (1984) and Mishra (1986) who also noted significant reduction in cane yield attributes due to late planting.

Biological yield, sum of cane, trash and green top yields varied significantly under different crop sequences. Autumn planted sugarcane produced significantly higher biological yield (124.9 and 100.7 t ha^{-1}) than other planting seasons. The decrease in biological yield under late planted crop was attributed to reduction in cane, trash and green top yields. Late spring planted sugarcane after wheat produced 45.7 and 35.1 per cent lower biological yield than autumn sugarcane. Such decrease under mustard spring sugarcane was 21.8 and 12.0 per cent over autumn planted sugarcane intercropped with mustard. These results are in agreement with the findings of Yadav and Sharma (1982) and Mishra (1986).

Genotypic variations in relation to yield were significant. Genotype CoPant 93227 produced 6.6 and 10.8, and 2.8 and 1.3 per cent more cane yield than CoPant 92226 and CoPant 90223 during 1998-2000 and 1999-2001, respectively. Higher cane yield in CoPant 93227 may be attributed to higher number of millable canes under this genotype. Genotype CoPant 93227 produced 8.3 and 4.7 thousand and 10.0 and 6.6 thousand ha^{-1} more millable canes than CoPant 90223 and CoPant 92226 during two seasons, respectively. Higher number of millable canes in CoPant 93227 was due higher initial shoot

population and more conversion ratio of shoots to number of millable canes. The cane length was more (253.0 and 242.9 cm) in CoPant 93227 than CoPant 92226 and CoPant 90223. Varietal differences in relation to biological yield were also significant during both the years. Genotype CoPant 93227 produced highest biological yield of 98.8 and 86.7 t ha⁻¹, being 1.4 and 1.0 t ha⁻¹ more than CoPant 90223 and 5.8 and 6.6 t ha⁻¹ more than CoPant 92226. Higher biological yield in CoPant 93227 was attributed to higher millable canes, green top, trash and cane yield. Similar observations have also noted by Das *et al.* (1996); Shushila *et al.* (1996) and Rao and Rao (2000).

Cropping systems and varietal interaction in relation to cane yield was significant indicating that genotype performs differently under different cropping systems. In autumn planted sugarcane + mustard intercrop, CoPant 93227 produced significantly higher cane yield than CoPant 92226 and CoPant 90223 indicating that CoPant 93227 performs better than other genotypes under autumn seasons. The number of millable canes in CoPant 93227 under autumn planted sugarcane was also higher (103.0 and 96.4 thousand ha⁻¹) than other genotypes.

Interaction between cropping systems and genotypes for biological yield was also significant and followed similar trend as that of cane yield. Autumn planted sugarcane of CoPant 93227 produced significantly higher biological yield (129.9 and 106.2 t ha⁻¹) than CoPant 90223 (124.2 and 101.3 t ha⁻¹) and CoPant 92226 (119.1 and 94.8 t ha⁻¹). Under wheat-late spring sugarcane crop sequences, CoPant 92226 recorded lowest biological yield (66.1 and 57.3 t ha⁻¹),

being significantly lower than other cropping systems during both the year. Variations in biological yield were similar to the number of millable canes, cane yields, trash and green top yield.

The variations in cane yield under different fertilizer levels were owing to difference in number of millable canes and weight per cane. Crop receiving 125 per cent of the recommended NPK produced 27.3 and 16.6 and 11.2 and 7.9 t ha⁻¹ more cane yield than that of 75 and 100 per cent of the recommended NPK. The number of millable canes under this treatments was 21.8 and 4.7, and 14.5 and 2.9 thousand ha⁻¹ more than that of 75 and 100 per cent of the recommended NPK indicating that there is need to increase the fertilizer dose by 25 per cent over recommended dose.

Significantly higher number of millable canes and cane yield with 125 per cent of the recommended dose of NPK may be attributed better initial growth as a result of adequate nutrients. The shoot mortality was also lower under this treatment might be due to adequate nutrients available for growth. The crop fertilized with 125 per cent of the recommended NPK removed 40.7 and 40.4, and 19.0 and 19.3 kg ha⁻¹ more N than that of 75 and 100 per cent of the recommended NPK during two years, respectively. The respective values of P and K were 3.5 and 2.8, and 1.8 and 1.1, 27.9 and 32.7 and 14.9 and 19.0 kg ha⁻¹ under 75 and 100 per cent of the recommended NPK. The results are in accordance with the findings of Kumaraswamy *et al.* (1992), Patel *et al.* (1993), Rajasekaren (1994) and Jamuna *et al.* (1994).

Autumn planted sugarcane yielded significantly higher commercial cane sugar (12.0 and 10.3 t ha⁻¹) than other planting seasons. Sugar yields obtained under mustard-spring sugarcane and wheat-late spring sugarcane crop were 47.5 and 43.7 per cent and 20.8 and 20.3 per cent lower than autumn crop. The commercial cane sugar is the function of per cent available sugar in cane and cane yield. The available sugar under autumn planted crop were 12.2 and 12.7 per cent against 11.5 and 11.1 per cent in late spring planted crop. The low sugar recovery in late planted sugarcane was further associated with poor juice quality in terms of brix and sucrose at all the stages of crop growth. At harvest (March) later spring planted crop exhibited minimum juice brix (17.2 and 17.6 per cent), being significantly lower than other planting seasons. Juice sucrose was also significantly lower (16.0 and 16.6 per cent) in late planted crop than autumn planted crop. On the other hand late spring planted crop followed wheat crop accumulated higher reducing sugars at all the stages during both the years. At harvest (March) reducing sugars in late spring planted crop were 1.00 and 0.99 per cent, whereas in autumn + mustard and spring planted crop following mustard crop contained 0.86 and 0.90, and 0.95 and 0.96 per cent reducing sugars in the juice. The poor juice quality in late spring planted crop followed wheat may be due to more proportion of immature stalks. Similar findings were also reported by Bachloo (1984) and Mishra (1986).

The other juice quality parameters like-juice brix, sucrose and purity per cent were also higher in CoPant 92226. At harvest (March) CoPant 92226

exhibited maximum juice brix (19.1 and 18.9 per cent) and sucrose (17.7 and 17.0 per cent), being significantly higher than other genotypes. Purity coefficients were also higher being 78.6 and 82.6 per cent in CoPant 92226 against 78.2 and 80.7 per cent in CoPant 90223 and 75.8 and 79.6 per cent in CoPant 93227, respectively. Large genotypic variations in quality parameters were also noted by Yadav and Sharma (1982) and Rana (1985).

Interaction between cropping system and genotypes with respect to sugar yield revealed (Table 22a) that under autumn + mustard planting season, genotype CoPant 93227 yielded significantly higher commercial cane sugar (12.6 and 11.3 t ha⁻¹) than CoPant 90223 (11.2 and 10.4 t ha⁻¹). However, under other cropping systems genotype CoPant 90223 performed better than CoPant 92226 and CoPant 93227. Higher sugar yield in CoPant 93227 under autumn + mustard planted crop may be owing to higher cane yield and better juice quality. Similar observations were made by Ramesh and Mahaderaswamy (1996), Ramdoyal *et al.* (2000) and Shfshak *et al.* (2001).

Interaction between cropping system and genotypes with respect to available sugar at harvest (March) revealed (Table 21a) that under autumn sugarcane intercropped with mustard genotype CoPant 92226 (12.6 and 13.2 per cent) recorded maximum available sugar, being significantly higher than CoPant 93227 (12.0 and 12.2 per cent) under mustard-spring sugarcane cropping system.

The commercial cane sugar is a product of cane yield and available sugar per cent in cane juice, which is governed by brix and sucrose content in juice is

affected by brix and reducing sugars content. Significantly higher sugar yield (10.3 and 9.0 t ha⁻¹) was recorded under 125 per cent of the recommended fertilizer levels as compared to 75 (7.9 and 7.1 t ha⁻¹) and 100 (9.5 and 8.1 t ha⁻¹) per cent fertilizer levels. Lower fertilizer level (75 per cent of the recommended NPK) recorded 23.3 and 21.1 per cent and 7.8 and 10.0 per cent lower sugar yield than 125 per cent of the recommended NPK during both the years. Differences in sugar yield were mainly due to variations in cane yield. Similar results have been reported by Banger and Sharma (1992), Patel *et al.* (1993) and Jamuna (1994).

Available sugar decreased significantly with higher doses of fertilizer at all the stages during both the years. This was because of significant reduction in sucrose content with higher dose of NPK levels. A progressive depression in juice sucrose associated with increased fertilizer levels was noted. Poor juice quality with higher fertilizer levels may be due to immature stalks and continued growth. Similar results were reported by Kapoor *et al.* (1993) and Singh *et al.* (1992). Higher fertilizer levels significantly decreased juice purity at all the stages during both the years. At harvest (March) maximum juice purity coefficient (79.1 and 82.5 per cent) was recorded under 75 per cent fertilizer levels, being significantly higher than that of 125 per cent of the recommended fertilizer levels. Higher (125 per cent) fertilizer levels attained 4.1 and 3.2 per cent lower juice purity than that of 75 per cent of the recommended NPK. This might be due to higher accumulation of nitrogen substances with reduction in

phosphorus. Similar results are reported by Kapoor *et al.* (1993) and Sathyavallu and Rajasekaran (1994).

Reducing sugars was affected significantly with higher doses of fertilizer at all the stages during both the years (Table 20). Reducing sugars increased with fertilizer levels. Higher (125 per cent) fertilizer levels attained 12.0 and 8.2 per cent and 6.0 and 3.1 per cent higher reducing sugars than 75 and 100 per cent of the recommended fertilizer levels. It may be due to increased invertase activity under higher fertilizer levels, which in turn was responsible for higher reducing sugars in juice. These findings are in conformity with the findings of Perumal *et al.* (1990) and Jamuna *et al.* (1994).

Extraction per cent differed significantly with higher levels of fertilizer at all the stages during both the years. At harvest (March) maximum extraction per cent was recorded with 125 per cent of fertilizer (48.5 and 48.7 per cent), being significantly higher than 75 per cent of fertilizer levels. The differences between 100 and 125 per cent of fertilizer were not significant. Maximum these extraction per cent was noted with higher fertilizer levels. This may be because of more succulence with less fibre under higher fertilizer doses (Patel *et al.*, 1993 and Jamuna, 1994).

Interaction between cropping systems and fertilizer levels with respect to juice sucrose revealed (Table 18c) that under autumn season crop fertilized with 75 per cent of the recommended fertilizer levels exhibited significantly higher juice sucrose (18.2 per cent) than that of 100 (17.5 per cent) and 125 (16.8 per

cent) per cent of the recommended NPK. Higher juice sucrose in autumn planted sugarcane may be owing to better juice quality in terms of higher juice brix and low reducing sugars. Interaction between cropping systems and fertilizer levels (Table 21b) revealed that autumn sugarcane intercropped with mustard attained maximum available sugar (13.0 and 13.0 per cent) with 75 per cent of fertilizer levels, being significantly higher than 125 per cent of fertilizer levels at par with 100 per cent of the recommended fertilizer levels. This was because of significant decrease in sucrose content under higher fertilizer levels.

**SUMMARY
AND
CONCLUSION**

6. SUMMARY AND CONCLUSION

A field experiment entitled “Nutritional requirement of sugarcane genotypes under different cropping systems” was conducted at the Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttaranchal), from October, 1998 to March, 2001. The experimental soil was silty clay loam, rich in organic carbon, medium in available phosphorus (12.5 kg ha^{-1}) and potassium (270.0 kg ha^{-1}) with neutral soil reaction (pH 7.2). The experiment consisted of three cropping systems (autumn sugarcane + mustard intercrop, mustard-spring sugarcane and wheat-late spring sugarcane), three genotypes (CoPant 90223, CoPant 92226 and CoPant 93227) and three fertilizer levels (75, 100 and 125 per cent of the recommended NPK). The experiment was laid out in split plot design, cropping systems and genotypes in main plot and fertilizer levels in sub-plot with three replications. The salient findings of the investigation are given below :

1. Spring planted crop after mustard, exhibited significantly higher germination than autumn sugarcane intercropped with mustard and late spring sugarcane following wheat crop. Genotype CoPant 93227 showed significantly higher germination (48.5 and 39.0 per cent) than CoPant 92226 and CoPant 93227 during 1998-2000. Application of NPK fertilizer did not affect cane, germination. However, higher germination was recorded with the 125 per cent of the recommended NPK doses than that of 75 and 100 per cent recommended dose of NPK.

2. Shoot population differed significantly due to cropping systems. Autumn sugarcane intercropped with mustard produced maximum shoot population during June. However, in spring and late spring sugarcane crops maximum shoot population was noted in July and August. Genotype CoPant 93227 produced maximum shoot population of 139.9 and 135.8 thousand ha^{-1} , being significantly higher than CoPant 90223 and CoPant 92226 during two years, respectively. Crop fertilized with 125 per cent of the recommended NPK produced significantly high number of shoots (138.4 and 133.7 thousand ha^{-1}) than 75 (117.3 and 113.4 thousand ha^{-1}) and 100 (130.1 and 125.4 thousand ha^{-1}) per cent of the recommended NPK during both the years.

Interaction between cropping systems and genotypes during July revealed that under wheat-late spring sugarcane crop sequence, CoPant 90223 produced significantly higher shoots (103.7 and 110.2 thousand ha^{-1}) than CoPant 92226 and CoPant 93227 during both the years. However, under autumn sugarcane intercropped with mustard and mustard-spring sugarcane crop sequence, CoPant 93227 produced significantly higher shoot population.

Autumn sugarcane intercropped with mustard exhibited maximum shoot height, being significantly higher than spring and late spring planted sugarcane after mustard and wheat harvest during both the years. Genotype, CoPant 93227 recorded maximum shoots height of 154.9 and 157.4 cm, being significantly higher than CoPant

90223 (142.3 and 145.1 cm). Significantly higher shoots height (164.1 and 167.6 cm) was recorded with 125 per cent of the recommended NPK than 75 and 100 per cent of the recommended NPK during both the years.

The interaction between cropping systems and genotypes for shoot height noted in August revealed that CoPant 93227 and CoPant 92226, being at par, attained significantly higher shoots height than that of CoPant 90223 under autumn sugarcane + mustard intercrop, crop sequence during both the years.

3. During August dry matter accumulation per shoot was maximum (255.3 and 246.3 g/shoot) under autumn sugarcane intercropped with mustard, being significantly higher than spring and late spring sugarcane during both the crop season. Genotype, CoPant 92226 produced significantly higher dry matter (189.7 and 182.2 g/shoot), than CoPant 90223 and CoPant 93227. Crop fertilized with 125 per cent of recommended NPK attained maximum dry matter of 191.1 and 183.4 g/shoot, being significantly higher than that of 75 and 100 per cent of the recommended NPK during both the years.
4. Autumn sugarcane intercropped with mustard recorded significantly higher cane length (259.8 and 269.7 cm) than spring and late spring planted sugarcane after mustard and wheat harvest during both the years. Genotypes, CoPant 93227 exhibited higher cane length (253.0 and 242.9 cm) than CoPant 90223 (242.7 and 211.1 cm).

5. Individual cane weight higher (828 and 821 g) with autumn sugarcane than mustard-spring and wheat-late spring crop sequence during both the years. Genotype CoPant 92226 exhibited heaviest cane weight (842 and 843 g), being significantly higher than CoPant 90223 (777 and 749 g) and CoPant 93227 (761 and 658 g). Crop fertilized with 125 per cent of recommended NPK attained significantly higher cane weight (853 and 742 g) than that of 75 and 100 per cent of recommended NPK during both the years.

Interaction between cropping systems and genotypes with respect to average cane weight revealed that during 1998-2000 under autumn planted sugarcane intercropped mustard crop sequence. CoPant 92226 recorded significantly higher cane weight (891 and 914 g) than that of CoPant 90223 and CoPant 93227. However, under mustard-spring crop sequences, difference in cane weight between CoPant 90223 and CoPant 92226 were not significant.

Interaction between cropping systems and fertilizer levels exhibited that during 1998-2000, autumn sugarcane crop intercropped with mustard, crop receiving 125 per cent of recommended NPK produced significantly higher average cane weight (899 g) than that of 75 (767 g) and (819 g) per cent of recommended NPK.

6. Autumn sugarcane intercrop with mustard produced 21.4 and 4.6 thousand and 43.9 and 20.1 thousand per hectare more millable canes than spring and late spring planted sugarcane, respectively. Genotype

- CoPant 93227 produced significantly higher millable cane (103.0 and 96.4 thousand ha^{-1}) than CoPant 90223. Crop receiving 125 per cent of the recommended NPK produced (105.7 and 94.6 thousand ha^{-1}) millable canes than 75 and 100 per cent of the recommended NPK during both the years, respectively. Interaction between cropping systems and genotypes revealed that autumn sugarcane intercropped with mustard and mustard-spring sugarcane crop sequence, CoPant 93227 recorded significantly higher number of millable canes being significantly higher than that of CoPant 90223 and CoPant 92226. Interaction between cropping systems and fertilizer levels revealed that under autumn sugarcane intercropped with mustard, crop fertilized with 125 per cent of recommended NPK produced significantly higher number of millable canes than that of 75 and 100 per cent of recommended NPK.
7. Differences in cropping systems with respect of cane yield, revealed that autumn sugarcane intercropped with mustard produced significantly higher cane yield of 99.0 and 80.0 t ha^{-1} against 78.0 and 70.3 t ha^{-1} in spring and 55.2 and 51.9 t ha^{-1} in late spring planted sugarcane during two years, respectively. Genotype, CoPant 92226 produced significantly higher cane yield (79.2 and 70.1 t ha^{-1}) than Crop 93227.

Maximum cane yield of 90.0 and 75.7 t ha^{-1} was noted under 125 per cent of the recommended NPK, being significantly higher than that of 75 (62.7 and 59.1 t ha^{-1}) and 100 (78.8 and 67.8 t ha^{-1}) per cent of the recommended NPK during 1998-2000 and 1999-2001, respectively.

Interaction between cropping systems and genotypes indicated that CoPant 92226 gave significantly higher cane yield (103.8 t ha^{-1}) than CoPant 90223, under autumn planting. Interaction between cropping systems and fertilizer levels revealed that increasing fertilizer levels from 75 to 125 per cent of recommended NPK significantly improved the cane yield under autumn sugarcane + mustard and mustard-spring sugarcane crop sequences. All genotypes yielded at par under 75 per cent of recommended NPK. However, under 100 and 125 per cent of the recommended NPK, CoPant 92226 yielded significantly higher than that of CoPant 93227.

8. Autumn sugarcane intercropped with mustard exhibited significantly higher biological yield of 124.9 and 100.7 t ha^{-1} than that of 97.7 and 88.6 t ha^{-1} in mustard spring sugarcane and of 67.8 and 65.4 t ha^{-1} in wheat late spring sugarcane cropping systems during both the years, respectively. Genotype CoPant 92226 produced significantly higher biological yield (98.8 and 86.7 t ha^{-1}) than that of CoPant 93227. Significantly higher biological yield of 112.5 and 96.2 t ha^{-1} was recorded with 125 per cent of the recommended NPK than 75 and 100 per cent of the recommended NPK during both the years, respectively.
9. Quality characters like juice brix, sucrose, purity coefficient, available sugar and reducing sugars varied significantly owing to cropping systems, genotypes and fertilizer (NPK) levels. Autumn sugarcane intercropped with mustard recorded higher juice brix, sucrose, available sugar and

purity coefficient than other cropping systems. Genotype, CoPant 92226 performed better with respect to quality parameters, than CoPant 93227. All the quality parameters were significantly higher under 75 per cent of the recommended NPK.

Interactions between cropping systems and genotypes at harvesting (March) revealed that under autumn sugarcane + mustard intercropped crop sequence, CoPant 92226, being at par with CoPant 90223 exhibited significantly higher available sugar than that of CoPant 93227.

Interaction between cropping systems and fertilizer levels revealed that wheat-late spring sugarcane crop sequence, crop fertilized with 125 per cent of the recommended NPK exhibited significantly lower available sugar than that of 75 and 100 per cent of the recommended NPK.

Interaction between cropping systems and genotypes with respect to purity coefficient at harvesting (March) revealed that all genotypes exhibited statistically similar juice purity under autumn and spring season sugarcane. However, under late spring planting after wheat genotypes CoPant 90223 and CoPant 92226, being at par exhibited significantly higher juice purity than CoPant 93227.

The interaction between cropping systems and genotypes with respect to juice sucrose revealed that during March, CoPant 92226 produced significantly higher juice sucrose than that of CoPant 93227 and CoPant 90223 and autumn sugarcane intercropped with mustard crop sequence.

10. Cropping systems differed significantly with respect to commercial cane sugar. Maximum commercial cane sugar (12.0 and 10.3 tha^{-1}) was recorded in autumn sugarcane intercropped with mustard than spring and late spring sugarcane. Genotype, CoPant 92226 yielded maximum commercial cane sugar of 9.7 and 8.5 tha^{-1} , being significantly higher than that of CoPant 93227 (8.8 and 7.3 tha^{-1}) during two seasons, respectively. Increasing doses of fertilizer from 75 to 125 per cent of the recommended NPK increased sugar yield. Interaction between cropping systems and genotypes with respect to sugar yield indicated that autumn season planting of CoPant 92226 when intercropped with mustard produced significantly higher sugar yield than that of CoPant 90223 and CoPant 93227. However, spring and late spring seasons, varietal differences were not significant.

Conclusion

Autumn sugarcane intercropped with mustard gave 16.6 and 39.6 per cent higher cane yield than sugarcane planted after mustard and wheat, respectively. Among the genotypes, CoPant 93227 was superior to CoPant 92226 and CoPant 90223 in giving 8.6 and 2.6 per cent more cane yield, respectively. Quality wise CoPant 92226 was however, superior to rest of the genotypes. Autumn cane+mustard (divya) cropping systems required 25 per cent more fertilizer ($150 \text{ N: } 100 \text{ P}_2\text{O}_5: 50 \text{ K}_2\text{O, kg ha}^{-1}$) than spring and late spring sugarcane crops following mustard (Kranti) and wheat (UP 2338), respectively. CoPant 93227 out yielded CoPant 92226 and CoPant 90223 under autumn season.

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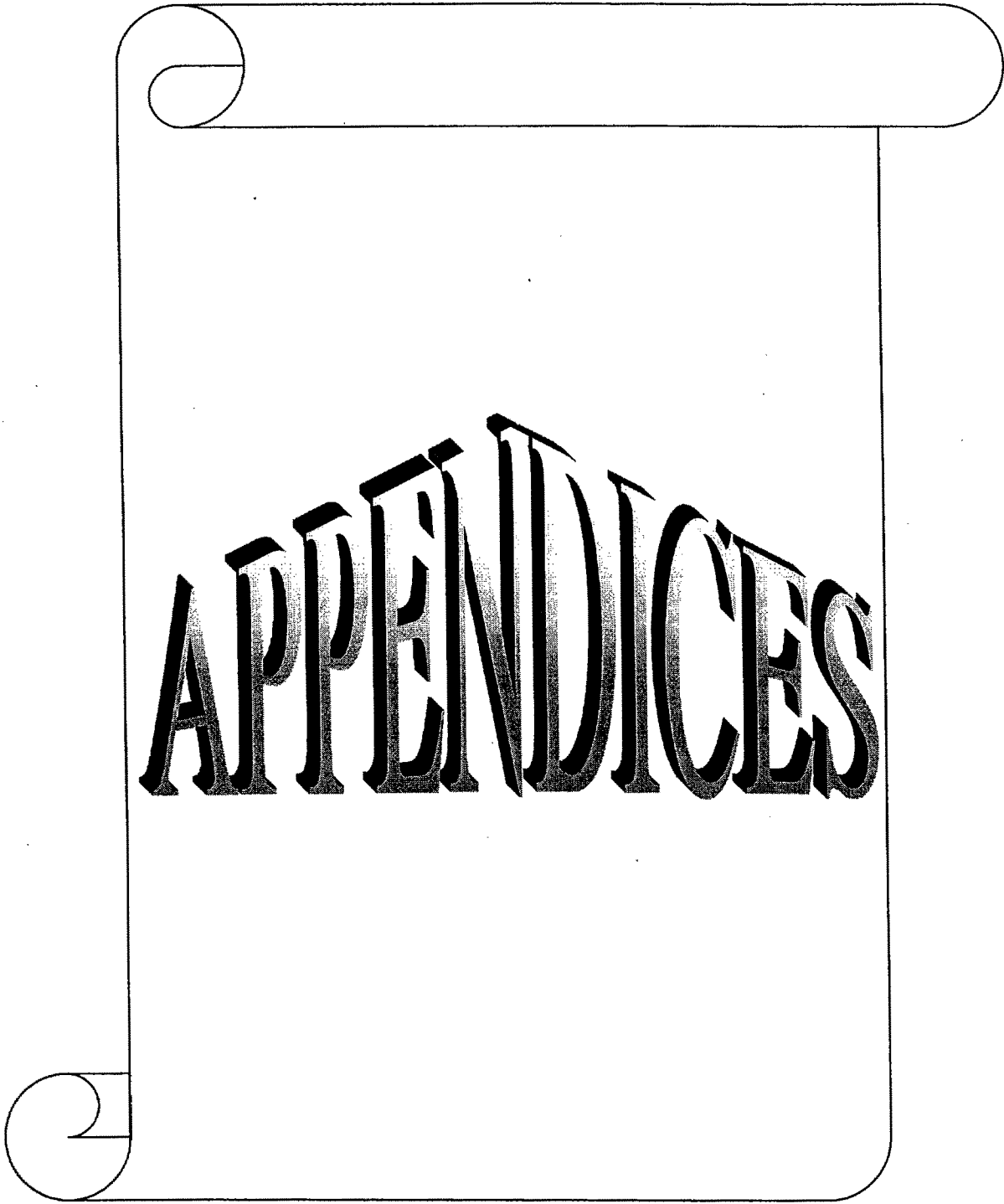
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APPENDICES

APPENDIX-I

Meteorological data for the crop seasons of 1998-2000 and 1999-2001

Months	Temperature (°C)		Mean	Rainfall (mm)	Sunshine (hrs/day)
	Maximum	Minimum	RH (%)		
October, 1998	30.4	19.7	73.5	292.2	7.8
November	24.7	12.9	71.5	7.6	8.7
December	22.7	7.0	72.5	-	7.0
January, 1999	17.7	7.4	81.5	92.0	3.6
February	23.9	9.0	74.5	-	6.2
March	29.7	11.2	59.5	-	9.9
April	38.0	16.7	43.5	-	10.2
May	36.7	22.1	54.0	172.6	9.8
June	34.4	24.7	64.0	261.2	8.4
July	32.3	25.4	80.5	733.2	4.6
August	31.9	25.3	81.0	541.2	5.1
September	31.6	23.1	85.0	767.6	4.7
October	30.4	217.9	74.5	190.8	8.9
November	27.7	10.8	62.5	-	9.0
December	23.6	7.7	68.5	30.4	7.3
January, 2000	18.7	6.9	79.0	14.4	4.9
February	21.0	7.1	70.0	95.2	7.9
March	27.7	10.8	60.0	23.6	9.2
April	35.6	18.2	48.5	6.8	10.3
May	34.9	23.7	59.5	325.8	7.8
June	32.4	24.5	76.5	548.8	5.4
July	31.6	25.3	81.5	405.2	5.2
August	30.1	24.8	84.0	1154.6	4.9
September	31.1	22.8	79.5	641.6	6.7
October	31.4	18.3	68.0	1.6	8.9
November	27.4	12.4	69.5	1.0	7.5
December	23.2	7.0	68.0	-	6.9
January, 2001	18.3	5.6	77.5	23.6	5.6
February	23.8	7.3	69.5	20.6	8.3
March	28.3	11.4	59.5	3.4	8.5

Analysis of variance for germination per cent

Source of Variation	d.f.	Mean Sum of Square			
		1998-2000		1999-2001	
		30 DAP	45 DAP	30 DAP	45 DAP
Replication	2	47.707	52.009	31.9275	50.821
Cropping System (M_1)	2	323.726*	524.037*	4830.90*	6132.38*
Varieties (M_2)	2	257.393*	270.222*	101.594	96.691
Cropping System (M_1) x Varieties (M_2)	4	10.336	16.519	85.514	87.686
Error (Main)	16	5.084	6.985	84.052	94.063
Fertility levels (Sub)	2	6.369	1.769	267.256	296.835
Cropping System (M_1) x Fertility levels (Sub)	4	2.149	3.677	15.227	23.923
Varieties (M_2) x Fertility levels (Sub)	4	62.612	24.265	12.646	14.417
M_1 x M_2 x Sub	8	6.528	12.003	14.267	21.138
Error (Sub)	36	12.143	11.472	25.869	27.833

* Significant at 5 per cent Probability

Analysis of variance for number of shoot (000 ha⁻¹)

Source of Variation	d.f.	d.f.	Mean Sum of Square							
			1998-2000							
			Month of observation							
			March	April	May	June	July	August		
Replication	2		56.25	581.97	9730.84	98.15	1751.31	930.99		
Cropping System (M_1)	2		-	1287.00*	61942.20*	26645.30*	29401.60*	12848.20*		
Varieties (M_2)	2		289.00*	1660.68*	11843.40*	4621.52*	3514.42*	3876.40*		
Cropping System (M_1) X Varieties (M_2)	4		-	150.67	8618.28	2383.80	3100.31*	2013.72*		
Error (Main)	16		-	66.21	9548.13	111.93	128.16	183.59		
Fertility levels (Sub)	2		224.21*	496.47*	125.35.90*	910.37*	2793.82*	3365.81*		
Cropping System (M_1) x Fertility levels (Sub)	4		-	40.49	10119.00	478.20	25.49	107.40		
Varieties (M_2) x Fertility levels (Sub)	4		49.71	9.19	9540.76	132.85	91.49	53.07		
M_1 x M_2 x Sub	8		-	57.16	9254.56	93.09	53.47	125.20		
Error (Sub)	36		54.37	57.81	10872.00	278.73	284.00	194.77		
* Significant at 5 per cent Probability										

Appendix-IV

Analysis of variance for number of shoots (000 ha⁻¹)

Source of Variation	d. f.	d. f.	Mean Sum of Square					
			1999-2001					
			Month of observation					
			March	April	May	June	July	August
Replication	2		356.27	144.98	1330.25	144.98	749.729	400.61
Cropping System (M ₁)	2		-	11261.00*	48112.60*	11261.00*	29033.20*	12881.60*
Varieties (M ₂)	2		294.89*	1320.74*	3003.23*	1320.74*	3738.95*	4030.09*
Cropping System (M ₁) X Varieties (M ₂)	4		-	346.61	935.84	346.61	3308.77*	1987.73*
Error (Main)	16		-	446.99	634.63	446.98	221.66	263.503
Fertility levels (Sub)	2		298.91*	1264.10*	2707.94*	1264.10*	2731.36*	3096.91*
Cropping System (M ₁) x Fertility levels (Sub)	4		-	7.85	577.54	7.85	750.15	171.71
Varieties (M ₂) x Fertility levels (Sub)	4		24.39	52.34	70.54	52.34	78.79	33.09
M ₁ x M ₂ x Sub	8		-	28.12	133.74	28.12	63.56	131.15
Error (Sub)	36		24	80.68	154.25	80.68	555.15	280.13

* Significant at 5 per cent Probability

Appendix-V

Analysis of variance for shoot height (cm)

Source of Variation	d.f	d.f.	Mean Sum of Square					
			1998-2000					
			Month of observation					
			March	April	May	June	July	August
Replication	2		28.58	5.07	563.51	132.99	1196.05	3099.39
Cropping System (M ₁)	2		-	-	-	1785.40*	16836.70*	43332.90*
Varieties (M ₂)	2		1829.89*	1818.25*	1409.58*	3008.51*	4883.33*	1224.28*
Cropping System (M ₁) X Varieties (M ₂)	4		-	-	-	1.27	1.19	422.32*
Error (Main)	16		-	-	-	73.40	497.48	63.39
Fertility levels (Sub)	2		177.88*	390.28*	301.61*	898.49*	4787.16*	6126.72*
Cropping System (M ₁) x Fertility levels (Sub)	4		-	-	-	5.27	203.97	448.88*
Varieties (M ₂) x Fertility levels (Sub)	4		2.63	2.11	3.76	9.25	6.88	49.21
M ₁ x M ₂ x Sub	8		-	-	-	4.65	2.31	40.57
Error (Sub)	36		68.98	45.39	2.76	70.46	142.72	20.17

* Significant at 5 per cent Probability

Appendix-VI

Analysis of variance for shoot height (cm)

Source of Variation	d. f.	d. f.	Mean Sum of Square					
			1999-2001					
			Month of observation					
			March	April	May	June	July	August
Replication	2		823.85	293.12	416.22	140.72	16.39	1324.66
Cropping System (M ₁)	2		-	-	-	1737.47*	15847.90*	42821.20*
Varieties (M ₂)	2		1707.45*	1604.72*	1470.82*	2801.22*	4839.95*	1212.73*
Cropping System (M ₁) X Varieties (M ₂)	4		-	-	-	1.45	6.65	458.31*
Error (Main)	16		-	-	-	52.16	195.97	85.20
Fertility levels (Sub)	2		176.35*	285.95*	263.10*	944.19*	4835.36*	5778.66*
Cropping System (M ₁) x Fertility levels (Sub)	4		-	-	-	0.93	234.31	408.53*
Varieties (M ₂) x Fertility levels (Sub)	4		2.59	0.62	3.33	6.75	12.35	43.31
M ₁ x M ₂ x Sub	8		-	-	-	1.25	9.93	27.68
Error (Sub)	36		49.09	40.53	2.94	52.56	213.00	27.21
* Significant at 5 per cent Probability								

Appendix-VII

Analysis of variance for dry matter accumulation (g/shoot) at different stages of crop growth

Source of Variation	d.f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		June	July	August	
Replication	2	212.16	425.407	1235.220	
Cropping System (M ₁)	2	189038.00*	152322.00*	112355.00*	
Varieties (M ₂)	2	84.72	148.000	375.366*	
Cropping System (M ₁) X Varieties (M ₂)	4	17.973	12.2960	18.6127	
Error (Main)	16	61.84	95.754	7.2433	
Fertility levels (Sub)	2	200.16*	252.296*	694.773*	
Cropping System (M ₁) x Fertility levels (Sub)	4	1.53	4.7034	1.4645	
Varieties (M ₂) x Fertility levels (Sub)	4	0.41	1.3518	4.9097	
M ₁ x M ₂ x Sub	8	0.750	0.4261	2.1612	
Error (Sub)	36	9.14	3.7530	3.2685	
* Significant at 5 per cent Probability					

Appendix-VIII

Analysis of variance for dry matter accumulation (g/shoot) at different stages of crop growth

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		June	July	August	
Replication	2	325.17	1031.43	1076.88	
Cropping System (M ₁)	2	186561.00*	146190.00*	107470.00*	
Varieties (M ₂)	2	84.50	148.019	379.102*	
Cropping System (M ₁) X Varieties (M ₂)	4	18.16	12.330	18.414	
Error (Main)	16	12.37	22.906	6.980	
Fertility levels (Sub)	2	200.00*	252.315*	695.250*	
Cropping System (M ₁) x Fertility levels (Sub)	4	2.67	4.686	1.339	
Varieties (M ₂) x Fertility levels (Sub)	4	1.00	1.333	5.116	
M ₁ x M ₂ x Sub	8	1.67	1.497	2.140	
Error (Sub)	36	7.42	15.296	2.645	

* Significant at 5 per cent Probability

Appendix-IX

Analysis of variance for leaf area index at different stages of crop growth

Source of Variation	d.f.	d.f.	Mean Sum of Square							
			1998-2000							
			Month of observation							
			March-April	April-May	May-June	June-July	July-August	August-September		
Replication	2	2	0.0018	0.0037	0.006	0.006	0.004	0.005		
Cropping System (M ₁)	2	2	0.0174*	1.297*	4.177*	3.925	7.344*	12.425*		
Varieties (M ₂)	2	2	-	0.136*	0.596*	0.0528	0.448*	0.162*		
Cropping System (M ₁) X Varieties (M ₂)	4	4	-	0.001	0.150	0.361	0.009	0.005		
Error (Main)	16	4	0.0005	0.0011	0.0008	0.0008	0.002	0.002		
Fertility levels (Sub)	2	2	0.0196*	0.259*	0.525*	0.227	0.513*	0.403*		
Cropping System (M ₁) x Fertility levels (Sub)	4	4	0.0003	0.016	0.039	0.018	0.005	0.0004		
Varieties (M ₂) x Fertility levels (Sub)	4	4	-	0.001	0.011	0.100	0.070	0.0009		
M ₁ x M ₂ x Sub	8	8	-	0.0008	0.009	0.094	0.002	0.0042		
Error (Sub)	36	12	0.0017	0.001	0.001	0.001	0.001	0.0012		

* Significant at 5 per cent Probability

Appendix-X
Analysis of variance for leaf area index at different stages of crop growth

Source of Variation	d.f.	d.f.	Mean Sum of Square						
			1999-2001						
			Month of observation						
			March-April	April-May	May-June	June-July	July-August	August-September	
Replication	2	2	0.0018	0.0035	0.006	0.006	0.004	0.005	
Cropping System (M ₁)	2	2	0.0174*	1.275*	4.173*	3.936*	7.322*	12.425*	
Varieties (M ₂)	2	2	-	0.134*	0.602*	0.053*	0.445*	0.162*	
Cropping System (M ₁) X Varieties (M ₂)	4	4	-	0.001	0.150	0.362	0.010	0.005	
Error (Main)	16	4	0.0004	0.0012	0.0009	0.0008	0.002	0.002	
Fertility levels (Sub)	2	2	0.0018*	0.264*	0.522*	0.225*	0.519*	0.403*	
Cropping System (M ₁) x Fertility levels (Sub)	4	4	0.0003	0.015	0.040	0.018	0.005	0.0004	
Varieties (M ₂) x Fertility levels (Sub)	4	4	-	0.0008	0.013	0.099	0.007	0.0009	
M ₁ x M ₂ x Sub	8	8	-	0.0007	0.0098	0.094	0.002	0.0042	
Error (Sub)	36	12	0.0018	0.0015	0.0015	0.0015	0.001	0.0012	
* Significant at 5 per cent Probability									

Appendix-XI
Analysis of variance for nitrogen per cent in cane

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		June	July	August	
Replication	2	0.1328	0.12396	0.10961	
Cropping System (M ₁)	2	2.030*	1.4597*	0.8302*	
Varieties (M ₂)	2	0.0079*	0.01107*	0.01021	
Cropping System (M ₁) X Varieties (M ₂)	4	0.00011	0.000008	0.000077	
Error (Main)	16	0.0019	0.000051	0.000615	
Fertility levels (Sub)	2	0.0092*	0.0170*	0.01765*	
Cropping System (M ₁) x Fertility levels (Sub)	4	0.000014	0.00035	0.00181	
Varieties (M ₂) x Fertility levels (Sub)	4	0.000041	0.00008	0.000159	
M ₁ x M ₂ x Sub	8	0.00015	0.00015	0.00013	
Error (Sub)	36	0.00103	0.00062	0.00105	
* Significant at 5 per cent Probability					

Appendix-XII

Analysis of variance for nitrogen content per cent in cane

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Month of observation		
		June	July	August
Replication	2	0.0082	0.01700	0.01434
Cropping System (M ₁)	2	1.9267*	1.55034*	0.88351*
Varieties (M ₂)	2	0.0079	0.01667	0.01021
Cropping System (M ₁) X Varieties (M ₂)	4	0.00012	0.000877	0.000079
Error (Main)	16	0.0143	0.00493	0.006666
Fertility levels (Sub)	2	0.0092*	0.01991*	0.017641*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.000017	0.002109	0.001813
Varieties (M ₂) x Fertility levels (Sub)	4	0.000041	0.00144	0.000165
M ₁ x M ₂ x Sub	8	0.00014	0.00085	0.000125
Error (Sub)	36	0.0011	0.000692	0.001293

* Significant at 5 per cent Probability

Appendix-XIII

Analysis of variance for phosphorus content in cane

Source of Variation	d. f.	Mean Sum of Square		
		1998-2000		
		Month of observation		
		June	July	August
Replication	2	0.00257	0.000154	0.01275
Cropping System (M ₁)	2	0.01439*	0.000152*	0.0081
Varieties (M ₂)	2	0.000197	0.000154*	0.0035
Cropping System (M ₁) X Varieties (M ₂)	4	0.00066	0.000155	0.01088
Error (Main)	16	0.00033	0.000155	0.00949
Fertility levels (Sub)	2	0.00209*	0.000154*	0.010524
Cropping System (M ₁) x Fertility levels (Sub)	4	0.00025	0.000154	0.00926
Varieties (M ₂) x Fertility levels (Sub)	4	0.00046	0.000154	0.01118
M ₁ x M ₂ x Sub	8	0.00032	0.000154	0.009001
Error (Sub)	36	0.00037	0.000154	0.00967

* Significant at 5 per cent Probability

Appendix-XIV

Analysis of variance for phosphorus content in cane

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Month of observation		
		June	July	August
Replication	2	0.000778	0.001145	0.00059
Cropping System (M_1)	2	0.02124*	0.01023*	0.00287*
Varieties (M_2)	2	0.00084*	0.001777*	0.001123*
Cropping System (M_1) X Varieties (M_2)	4	0.00002	0.000058	0.000069
Error (Main)	16	0.00019	0.000015	0.000055
Fertility levels (Sub)	2	0.00068*	0.001241*	0.001365*
Cropping System (M_1) x Fertility levels (Sub)	4	0.000023	0.0000127	0.0000106
Varieties (M_2) x Fertility levels (Sub)	4	0.0000045	0.0000095	0.0000155
M_1 x M_2 x Sub	8	0.0000080	0.000014	0.0000108
Error (Sub)	36	0.0000082	0.0000032	0.0000044
* Significant at 5 per cent Probability				

Appendix-XV

Analysis of variance for potassium content in cane

Source of Variation	d. f.	Mean Sum of Square		
		1998-2000		
		Month of observation		
		June	July	August
Replication	2	0.11202	0.02642	0.30012
Cropping System (M_1)	2	0.9847*	0.30667*	0.14157*
Varieties (M_2)	2	0.2278*	0.39099*	0.40434*
Cropping System (M_1) X Varieties (M_2)	4	0.0016	0.00338	0.01808
Error (Main)	16	0.0463	0.03285	0.00952
Fertility levels (Sub)	2	0.2227*	0.34959*	0.43730*
Cropping System (M_1) x Fertility levels (Sub)	4	0.00046	0.00298	0.013577
Varieties (M_2) x Fertility levels (Sub)	4	0.00253	0.00726	0.01661
M_1 x M_2 x Sub	8	0.00179		0.02117
Error (Sub)	36	0.00214	0.00114	0.011008
* Significant at 5 per cent Probability				

Appendix-XVI

Analysis of variance for potassium content in cane

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Month of observation		
		June	July	August
Replication	2	0.0716	0.00439	0.00241
Cropping System (M ₁)	2	1.0542*	0.32076*	0.09356*
Varieties (M ₂)	2	0.2228*	0.36856*	0.30906*
Cropping System (M ₁) X Varieties (M ₂)	4	0.00216	0.00412	0.01214
Error (Main)	16	0.0229	0.00300	0.00095
Fertility levels (Sub)	2	0.2272*	0.34001*	0.3354*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.00073	0.001415	0.00347
Varieties (M ₂) x Fertility levels (Sub)	4	0.00279	0.008519	0.00596
M ₁ x M ₂ x Sub	8	0.00207	0.00399	0.00605
Error (Sub)	36	0.00184	0.000468	0.00044

* Significant at 5 per cent Probability

Appendix-XVII

Analysis of variance for cane yield attributes

Source of Variation	d.f.	Mean Sum of Square				
		1998-2000				
		Month of observation				
		Cane length (cm)	Individual cane weight	No. of internodes	Cane girth (cm)	NMC (000 ha ⁻¹)
Replication	2	17308.40	389.61	0.918	0.295	11.785
Cropping System (M ₁)	2	39322.10*	3719.54*	98.193*	2.302*	15657.30*
Varieties (M ₂)	2	49261.00*	933.17*	52.793*	1.331*	789.30*
Cropping System (M ₁) X Varieties (M ₂)	4	2334.22*	489.34*	9.877	0.386	35.92
Error (Main)	16	3700.67	405.81	3.607	0.164	46.13
Fertility levels (Sub)	2	85501.60*	1597.76*	17.612*	3.419*	3523.30*
Cropping System (M ₁) x Fertility levels (Sub)	4	1786.37*	53.49*	1.458	0.079	148.64
Varieties (M ₂) x Fertility levels (Sub)	4	629.33	249.67	1.459	0.239	18.82
M ₁ x M ₂ x Sub	8	828.52	80.38	1.029	0.129	9.73
Error (Sub)	36	1968.98	321.41	2.925	0.389	237.96

* Significant at 5 per cent Probability

Appendix-XVIII

Analysis of variance for cane yield attributes

Source of Variation	d. f.	Mean Sum of Square					
		1999-2001					
		Observation at harvest					
		Cane length (cm)	Per cane Weight (g)	Number of internodes	Cane girth (cm)	NMC (000 ha ⁻¹)	
Replication	2	1539.33	429.574	1.186	1.384	40.726	
Cropping System (M ₁)	2	122250.00*	47988.50*	214.261*	1.267*	3172.80*	
Varieties (M ₂)	2	231506.00*	6522.31*	52.766*	1.137*	1326.10*	
Cropping System (M ₁) X Varieties (M ₂)	4	1705.00*	648.88*	17.161	5.334	294.79	
Error (Main)	16	1166.25	1534.69	2.603	0.195	14.054	
Fertility levels (Sub)	2	23740.20*	1211.35*	17.483*	0.445*	1485.80	
Cropping System (M ₁) x Fertility levels (Sub)	4	1684.55*	2046.81*	0.875	0.204	23.785	
Varieties (M ₂) x Fertility levels (Sub)	4	1270.33	1866.36	1.963	1.822	30.748	
M ₁ x M ₂ x Sub	8	1573.50	945.38	2.463	0.177	32.183	
Error (Sub)	36	393.037	1283.94	2.914	0.332	12.852	
* Significant at 5 per cent Probability							

Appendix-XIX

Analysis of variance for cane, green top, trash and biological yield (t ha⁻¹)

Source of Variation	d.f.	Mean Sum of Square			
		1998-2000			
		Observation at harvest			
		Cane	Green top	Trash	Biological
Replication	2	27.146	4.143	0.743	1.194
Cropping System (M ₁)	2	5647.13*	90.459*	75.636*	868.34*
Varieties (M ₂)	2	520.998*	6.435	3.918*	488.38*
Cropping System (M ₁) X Varieties (M ₂)	4	133.531*	2.964	2.911	201.986*
Error (Main)	16	67.838	2.334	1.532	25.608
Fertility levels (Sub)	2	1875.28*	60.805*	56.248*	34.415*
Cropping System (M ₁) x Fertility levels (Sub)	4	31.781*	0.784	0.219	40.454*
Varieties (M ₂) x Fertility levels (Sub)	4	43.485*	0.608	1.778	58.060*
M ₁ x M ₂ x Sub	8	12.595	0.701	0.415	19.738
Error (Sub)	36	74.203	2.031	2.354	16.133

Appendix-XX

Analysis of variance for cane, green top, trash and biological yield (t/ha)						
Source of Variation		d. f.	Mean Sum of Square			
			1999-2001			
			Observation at harvest			
			Cane	Green top	Trash	Biological
Replication	2	46.517	4.624	1.802	41.356	
Cropping System (M ₁)	2	13154.90*	355.983*	252.338*	21778.40*	
Varieties (M ₂)	2	150.425*	4.531	7.742*	210.949*	
Cropping System (M ₁) X Varieties (M ₂)	4	46.436*	1.252	2.227	61.576*	
Error (Main)	16	36.691	2.151	1.238	37.388	
Fertility levels (Sub)	2	5052.05*	98.105*	65.521	7842.73*	
Cropping System (M ₁) x Fertility levels (Sub)	4	329.913*	6.261	2.548	471.520*	
Varieties (M ₂) x Fertility levels (Sub)	4	23.214*	0.2580	0.433	27.599*	
M ₁ x M ₂ x Sub	8	6.486	0.619	0.455	8.936	
Error (Sub)	36	22.944	5.917	3.337	38.226	
* Significant at 5 per cent Probability						

Appendix-XXI

Analysis of variance for dry matter (tha ⁻¹) at harvest		Mean Sum of Square						
Source of Variation		d.f.	Month of observation					
			1998-2000			1999-2001		
			Cane	Greentop	Trash	Cane	Greentop	Trash
Replication	2	260.857	2.825	27.439	288.634	1.061	3.044	
Cropping System (M ₁)	2	506.644*	5.889*	20.941*	484.652*	4.951*	18.881*	
Varieties (M ₂)	2	53.977	0.675*	8.569*	53.226*	0.532*	8.708*	
Cropping System (M ₁) X Varieties (M ₂)	4	0.423	0.016	0.006	0.226	0.004	0.025	
Error (Main)	16	22.788	0.164	0.243	0.743	0.008	0.042	
Fertility levels (Sub)	2	22.083*	0.522*	5.673*	23.583*	0.448*	5.673*	
Cropping System (M ₁) x Fertility levels (Sub)	4	0.344	0.014	0.003	0.246	0.008	0.006	
Varieties (M ₂) x Fertility levels (Sub)	4	0.551	0.022	0.057	0.741	0.013	0.041	
M ₁ x M ₂ x Sub	8	0.336	0.005	0.031	0.106	0.004	0.004	
Error (Sub)	36	0.638	0.033	0.124	0.585	0.005	0.06	

* Significant at 5 per cent Probability

Appendix-XXII

Analysis of variance for juice extraction per cent

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	0.615	0.185	3.065	0.672
Cropping System (M ₁)	2	165.309*	112.046*	84.148*	59.681*
Varieties (M ₂)	2	48.179*	24.481*	19.333*	18.070*
Cropping System (M ₁) X Varieties (M ₂)	4	5.001*	7.138	6.488	12.214*
Error (Main)	16	6.281	4.486	4.955	2.751
Fertility levels (Sub)	2	143.892*	87.222*	43.000	52.36*
Cropping System (M ₁) x Fertility levels (Sub)	4	4.391	2.920	0.603	3.935
Varieties (M ₂) x Fertility levels (Sub)	4	0.247	0.345	0.829	0.820
M ₁ x M ₂ x Sub	8	1.096	0.522	1.140	1.919
Error (Sub)	36	16.209	15.115	18.245	10.753
* Significant at 5 per cent Probability					

Appendix-XXIII

Analysis of variance for juice extraction percent

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.1962	1.4306	4.605	1.761
Cropping System (M ₁)	2	279.715*	282.153*	284.530*	323.826*
Varieties (M ₂)	2	79.205*	78.857*	82.734*	71.770*
Cropping System (M ₁) X Varieties (M ₂)	4	4.749*	4.4607	3.675	4.247*
Error (Main)	16	1.0814	7.250	7.576	0.856
Fertility levels (Sub)	2	163.150*	155.449*	151.493*	138.187*
Cropping System (M ₁) x Fertility levels (Sub)	4	1.9783	2.331	1.746	0.945
Varieties (M ₂) x Fertility levels (Sub)	4	1.209	1.254	0.655	1.379
M ₁ x M ₂ x Sub	8	1.133	1.441	1.044	0.861
Error (Sub)	36	0.570	11.700	17.569	14.294
* Significant at 5 per cent Probability					

Appendix-XXIV

Analysis of variance for juice brix per cent

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	0.934	0.067	0.895	1.357
Cropping System (M ₁)	2	7.551*	3.104*	2.114*	9.365*
Varieties (M ₂)	2	1.900*	1.761*	2.272*	9.466*
Cropping System (M ₁) X Varieties (M ₂)	4	0.990	0.768	2.036	0.629
Error (Main)	16	0.513	0.450	0.578	1.962
Fertility levels (Sub)	2	4.705*	3.396*	4.641*	12.684*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.428	0.074	0.062	0.133
Varieties (M ₂) x Fertility levels (Sub)	4	0.607	0.042	0.350	0.287
M ₁ x M ₂ x Sub	8	0.702	0.124	0.104	0.112
Error (Sub)	36	0.546	0.482	0.596	3.583
* Significant at 5 per cent Probability					

Appendix-XXV

Analysis of variance for juice brix per cent

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.552	0.103	0.013	2.974
Cropping System (M ₁)	2	12.710*	12.746*	12.781*	2.226*
Varieties (M ₂)	2	1.774*	2.505*	1.812*	8.757*
Cropping System (M ₁) X Varieties (M ₂)	4	0.569	0.348	0.519	0.395
Error (Main)	16	0.369	0.363	0.411	0.708
Fertility levels (Sub)	2	2.494*	9.191*	3.235*	5.493*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.514	0.035	0.158	0.084
Varieties (M ₂) x Fertility levels (Sub)	4	0.137	0.043	0.188	0.009
M ₁ x M ₂ x Sub	8	0.202	0.041	0.101	0.259
Error (Sub)	36	1.668	2.500	1.734	0.790
* Significant at 5 per cent Probability					

Appendix-XXVI

Analysis of variance for juice sucrose per cent

Source of Variation	d. f.	Mean Sum of Square 1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	1.9995	3.4726	0.2536	0.9022
Cropping System (M ₁)	2	8.6910*	7.6323*	6.5887	5.9739
Varieties (M ₂)	2	4.0828*	6.3059*	3.6153	6.3987
Cropping System (M ₁) X Varieties (M ₂)	4	0.4512	0.6372	0.7761*	0.5542*
Error (Main)	16	1.3521	1.4635	2.1714	2.1420
Fertility levels (Sub)	2	6.7518*	6.4992*	4.3699	14.7321*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.5004	0.2355	0.2330	0.0924*
Varieties (M ₂) x Fertility levels (Sub)	4	0.3119	0.1547	0.0322	0.1539*
M ₁ x M ₂ x Sub	8	0.2467	0.2652	0.3499	0.6631
Error (Sub)	36	1.0544	1.7568	1.4695	2.5559
* Significant at 5 per cent Probability					

Appendix-XXVII

Analysis of variance for juice sucrose per cent

Source of Variation	d. f.	Mean Sum of Square 1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.2544	7.2809	2.0255	1.5151
Cropping System (M ₁)	2	16.1908*	12.6530*	10.3501*	2.8125*
Varieties (M ₂)	2	6.1323*	6.3741*	5.4705*	4.0243*
Cropping System (M ₁) X Varieties (M ₂)	4	0.0522	0.0463	0.5164	0.1368*
Error (Main)	16	1.6968	0.7492	0.1485	0.0372
Fertility levels (Sub)	2	8.6792	11.7398*	13.3565*	38.1517*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.0287	0.3648	0.2487	0.3292*
Varieties (M ₂) x Fertility levels (Sub)	4	0.2029	0.1527	0.1889	1.51503*
M ₁ x M ₂ x Sub	8	0.0371	0.1145	0.1130	0.0755
Error (Sub)	36	4.9910	0.7044	0.1483	0.03703
* Significant at 5 per cent Probability					

Appendix-XXVIII

Analysis of variance for purity coefficient

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	4.15625	0.9508	3.8374	0.3571
Cropping System (M_1)	2	545.860*	451.229*	338.2630*	506.1350*
Varieties (M_2)	2	102.823*	87.5804*	95.1892*	60.2089*
Cropping System (M_1) X Varieties (M_2)	4	4.5839	4.0339	16.5906*	23.0391*
Error (Main)	16	6.4484	4.9037	4.3702	5.4163
Fertility levels (Sub)	2	96.9711*	105.2660*	60.4115*	66.3200*
Cropping System (M_1) x Fertility levels (Sub)	4	13.2737	8.2052	1.3545	8.4557
Varieties (M_2) x Fertility levels (Sub)	4	0.4034	1.4042	3.2526	0.2798
M_1 x M_2 x Sub	8	0.2190	0.05425	0.9131	1.1772
Error (Sub)	36	15.0756	18.6141	18.1055	21.7812
* Significant at 5 per cent Probability					

Appendix-XXIX

Analysis of variance for purity coefficient

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	5.326	1.2488	0.3264	1.0567
Cropping System (M_1)	2	62.307*	66.1007*	86.623*	68.9086*
Varieties (M_2)	2	87.399*	75.3785*	76.234*	77.9456*
Cropping System (M_1) X Varieties (M_2)	4	.04389	1.8247	2.0405*	1.6337*
Error (Main)	16	0.4792	1.4567	0.4123	2.3748
Fertility levels (Sub)	2	38.122*	56.5637*	54.845*	49.0938*
Cropping System (M_1) x Fertility levels (Sub)	4	0.7306	0.4404	0.2488	2.2679
Varieties (M_2) x Fertility levels (Sub)	4	0.2954	0.3571	0.05439	1.6522
M_1 x M_2 x Sub	8	0.3558	0.3371	0.3663	1.6137
Error (Sub)	36	9.9845	4.2409	11.4925	8.4512
* Significant at 5 per cent Probability					

Appendix-XXX

Analysis of variance for reducing sugars per cent

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	0.0075	6.8206	0.0058	0.00099
Cropping System (M_1)	2	0.6086*	0.2594*	0.08072*	0.0397*
Varieties (M_2)	2	0.9522*	0.7276*	0.1863*	0.1088*
Cropping System (M_1) X Varieties (M_2)	4	0.00738	0.00087	0.01245	0.0159
Error (Main)	16	0.00189	0.00204	0.00240	0.00134
Fertility levels (Sub)	2	0.1707*	0.6651*	0.0493*	0.0388*
Cropping System (M_1) x Fertility levels (Sub)	4	0.000204	0.00409	0.00121	0.00048
Varieties (M_2) x Fertility levels (Sub)	4	0.00190	0.00142	0.00088	0.000083
M_1 x M_2 x Sub	8	0.00174	0.00057	0.00211	0.00107
Error (Sub)	36	0.0123	0.00086	0.00479	0.00453
* Significant at 5 per cent Probability					

Appendix-XXXI

Analysis of variance for reducing sugars per cent

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.3902	0.00656	0.00129	0.00658
Cropping System (M_1)	2	0.69585*	0.75000*	0.06184*	0.10108*
Varieties (M_2)	2	1.31749*	0.68203*	0.0015*	0.08672*
Cropping System (M_1) X Varieties (M_2)	4	0.01024	0.01001	0.00934	0.00482*
Error (Main)	16	0.00683	0.00225	0.00109	0.00129
Fertility levels (Sub)	2	0.2832*	0.14977*	0.04569*	0.05489*
Cropping System (M_1) x Fertility levels (Sub)	4	0.00249	0.00442	0.00152	0.00031*
Varieties (M_2) x Fertility levels (Sub)	4	0.02318	0.01134	0.00094	0.00049
M_1 x M_2 x Sub	8	0.00789	0.00318	0.00140	0.0142
Error (Sub)	36	0.01217	0.01159	0.00696	0.00839
* Significant at 5 per cent Probability					

Appendix-XXXII

Analysis of variance for available sugar per cent

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	1.5183	0.6049	1.5159	2.0268
Cropping System (M_1)	2	10.7310*	6.3689*	7.3806*	18.9128*
Varieties (M_2)	2	3.6430*	4.6180*	3.6879*	2.3474*
Cropping System (M_1) X Varieties (M_2)	4	0.1924	0.1791	0.5926	0.7470*
Error (Main)	16	0.0369	0.0849	0.0372	0.1484
Fertility levels (Sub)	2	4.3027*	5.1695*	9.6549*	3.3283*
Cropping System (M_1) x Fertility levels (Sub)	4	0.0688	0.1188	0.1038	0.4762*
Varieties (M_2) x Fertility levels (Sub)	4	0.1780	0.1077	0.1256	0.1714
M_1 x M_2 x Sub	8	0.1052	0.0822	0.1156	0.1836
Error (Sub)	36	0.0371	0.0849	0.03706	0.1481
* Significant at 5 per cent Probability					

Appendix-XXXIII

Analysis of variance for available sugar per cent

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.0022	0.0026	0.1743	0.1283
Cropping System (M_1)	2	5.0449*	5.2523*	5.2909*	3.2632*
Varieties (M_2)	2	2.6711*	4.7115*	1.7582*	2.5716*
Cropping System (M_1) X Varieties (M_2)	4	0.3103	0.5899	0.1509	0.9237*
Error (Main)	16	0.3581	0.1559	0.2746	0.7786
Fertility levels (Sub)	2	3.6729*	4.4587*	3.1651*	0.9716*
Cropping System (M_1) x Fertility levels (Sub)	4	0.2882	0.3029	0.0948	0.3563*
Varieties (M_2) x Fertility levels (Sub)	4	0.2604	0.2173	0.2436	0.3048
M_1 x M_2 x Sub	8	0.2345	0.2121	0.1819	0.2983
Error (Sub)	36	0.5679	0.6806	1.1442	3.2151
* Significant at 5 per cent Probability					

Appendix-XXXIV
Analysis of variance for CCS and pooled cane yield (tha⁻¹)

Source of Variation	d.f.	Mean Sum of Square		
		CCS (tha ⁻¹)		Pooled yield (tha ⁻¹)
		1998-2000	1999-2001	
Replication	2	0.493	0.659	27.51
Cropping System (M ₁)	2	222.656*	133.199*	8957.07*
Varieties (M ₂)	2	5.009*	13.748*	163.46*
Cropping System (M ₁) X Varieties (M ₂)	4	0.784*	3.698*	76.38
Error (Main)	16	0.498	1.329	31.43
Fertility levels (Sub)	2	41.822*	24.265*	3270.31*
Cropping System (M ₁) x Fertility levels (Sub)	4	4.477	0.842	135.79
Varieties (M ₂) x Fertility levels (Sub)	4	0.156	0.626	22.41
M ₁ x M ₂ x Sub	8	0.185	0.342	5.99
Error (Sub)	36	1.981	0.991	22.52
* Significant at 5 per cent Probability				

Appendix-XXXV

Analysis of variance for juice pH

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		December	January	February	March
Replication	2	0.01218	0.00272	0.00439	0.01605
Cropping System (M ₁)	2	0.01016	0.00583	0.01105	0.00122
Varieties (M ₂)	2	0.01211	0.00445	0.00758	0.00462
Cropping System (M ₁) X Varieties (M ₂)	4	0.00724	0.00161	0.00828	0.00440
Error (Main)	16	0.00638	0.00563	0.01015	0.04339
Fertility levels (Sub)	2	0.14934*	0.06442*	0.16556*	0.12123*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.01360	0.00173	0.00318	0.00214
Varieties (M ₂) x Fertility levels (Sub)	4	0.03319	0.00248	0.00654	0.00538
M ₁ x M ₂ x Sub	8	0.00594	0.00121	0.00596	0.01754
Error (Sub)	36	0.01205	0.00420	0.00821	0.02171
* Significant at 5 per cent Probability					

Appendix-XXXVI

Analysis of variance for juice pH

Source of Variation	d. f.	Mean Sum of Square			
		1999-2001			
		Month of observation			
		December	January	February	March
Replication	2	0.00917	0.00889	0.02422	0.19618
Cropping System (M ₁)	2	0.04411*	0.00889*	0.00338*	279.715*
Varieties (M ₂)	2	0.00280*	0.00679*	0.00925*	79.205*
Cropping System (M ₁) X Varieties (M ₂)	4	0.01786	0.01155	0.01093	4.7490
Error (Main)	16	0.00747	0.00835	0.01950	1.0810
Fertility levels (Sub)	2	0.04736*	0.04441*	0.06458*	163.1500*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.00285	0.00214	0.00719	1.9780
Varieties (M ₂) x Fertility levels (Sub)	4	0.00239	0.00091	0.00534	1.2090
M ₁ x M ₂ x Sub	8	0.00195	0.00377	0.00513	1.1330
Error (Sub)	36	0.01729	0.01284	0.01036	0.5700
* Significant at 5 per cent Probability					

Appendix-XXXVII

Analysis of variance for nitrogen content at harvest

Source of Variation	d. f.	Mean Sum of Square			
		1998-2000			
		Month of observation			
		Cane	Green top	Trash	
Replication	2	0.16639	0.03281	0.04206	
Cropping System (M ₁)	2	0.09482*	0.05447*	0.08773*	
Varieties (M ₂)	2	0.04355*	0.01759*	0.03965*	
Cropping System (M ₁) X Varieties (M ₂)	4	0.00215	0.000195	0.00227	
Error (Main)	16	0.00116	0.000602	0.00025	
Fertility levels (Sub)	2	0.05424*	0.035112*	0.05741*	
Cropping System (M ₁) x Fertility levels (Sub)	4	0.00068	0.000172	0.00115	
Varieties (M ₂) x Fertility levels (Sub)	4	0.00006	0.000098	0.00013	
M ₁ x M ₂ x Sub	8	0.00038	0.000249	0.00043	
Error (Sub)	36	0.00151	0.000543	0.00072	
* Significant at 5 per cent Probability					

Appendix-XXXVIII

Analysis of variance for nitrogen content at harvest

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Observations at harvest		
		Cane	Green top	Trash
Replication	2	0.04089	0.03281	0.01272
Cropping System (M_1)	2	0.09070*	0.05447*	0.08401*
Varieties (M_2)	2	0.044201*	0.01759*	0.03942*
Cropping System (M_1) X Varieties (M_2)	4	0.002045	0.000195	0.002117
Error (Main)	16	0.001157	0.000602	0.00088
Fertility levels (Sub)	2	0.05549*	0.035112*	0.06129*
Cropping System (M_1) x Fertility levels (Sub)	4	0.00076	0.000172	0.001196
Varieties (M_2) x Fertility levels (Sub)	4	0.000085	0.000098	0.000232
M_1 x M_2 x Sub	8	0.00044	0.000249	0.000287
Error (Sub)	36	0.002117	0.000543	0.000542
* Significant at 5 per cent Probability				

Appendix-XXXIX

Analysis of variance for phosphorus content at harvest

Source of Variation	d. f.	Mean Sum of Square		
		1998-2000		
		Month of observation		
		Cane	Green top	Trash
Replication	2	0.00871	0.00161	0.00267
Cropping System (M_1)	2	0.00828	0.00070*	0.00062*
Varieties (M_2)	2	0.00299	0.00081*	0.00028
Cropping System (M_1) X Varieties (M_2)	4	0.01132	0.000004	0.00061
Error (Main)	16	0.00938	0.000058	0.000090
Fertility levels (Sub)	2	0.02271	0.00067*	0.00039*
Cropping System (M_1) x Fertility levels (Sub)	4	0.00449	0.0000005	0.0000012
Varieties (M_2) x Fertility levels (Sub)	4	0.00433	0.0000055	0.0000079
M_1 x M_2 x Sub	8	0.01131	0.0000019	0.0000009
Error (Sub)	36	0.00920	0.0000072	0.0000044
* Significant at 5 per cent Probability				

Appendix-XL

Analysis of variance for phosphorus content at harvest

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Observations at harvest		
		Cane	Green top	Trash
Replication	2	0.000701	0.00069	0.00544
Cropping System (M_1)	2	0.000729*	0.00067*	0.00914
Varieties (M_2)	2	0.000352*	0.00075*	0.00765
Cropping System (M_1) X Varieties (M_2)	4	0.000003	0.0000025	0.00514
Error (Main)	16	0.000002	0.0000022	0.00528
Fertility levels (Sub)	2	0.00036*	0.000665*	0.00589
Cropping System (M_1) x Fertility levels (Sub)	4	0.0000004	0.0000020	0.00529
Varieties (M_2) x Fertility levels (Sub)	4	0.000003	0.000001	0.00521
M_1 x M_2 x Sub	8	0.000002	0.0000019	0.00537
Error (Sub)	36	0.000002	0.0000019	0.00531

* Significant at 5 per cent Probability

Appendix-XLI

Analysis of variance for potassium content at harvest

Source of Variation	d. f.	Mean Sum of Square		
		1998-2000		
		Month of observation		
		Cane	Green top	Trash
Replication	2	0.36407	0.24656	0.29648
Cropping System (M_1)	2	0.03036*	0.02472*	0.01588*
Varieties (M_2)	2	0.01545*	0.19959*	0.02517*
Cropping System (M_1) X Varieties (M_2)	4	0.00017	0.00266	0.00132
Error (Main)	16	0.00145	0.00308	0.00128
Fertility levels (Sub)	2	0.02009*	0.16601*	0.03442*
Cropping System (M_1) x Fertility levels (Sub)	4	0.00071	0.00056	0.00021
Varieties (M_2) x Fertility levels (Sub)	4	0.00011	0.00052	0.00159
M_1 x M_2 x Sub	8	0.00049	0.00210	0.00049
Error (Sub)	36	0.00145	0.00358	0.00101

* Significant at 5 per cent Probability

Appendix-XLIV

Analysis of variance for phosphorus uptake (kg ha^{-1}) by different plant parts at harvest

* Significant at 5 per cent Probability

Analysis of variance for potassium uptake (kg ha^{-1}) by different plant parts at harvest

** Significant at 5 per cent Probability

Appendix-XLII

Analysis of variance for potassium content at harvest

Source of Variation	d. f.	Mean Sum of Square		
		1999-2001		
		Observations at harvest		
		Cane	Green top	Trash
Replication	2	0.01947	0.09864	0.02835
Cropping System (M ₁)	2	0.02925*	0.04077*	0.01444*
Varieties (M ₂)	2	0.01408*	0.11288*	0.02575*
Cropping System (M ₁) X Varieties (M ₂)	4	0.00012	0.01187	0.001292
Error (Main)	16	0.000075	0.01311	0.000096
Fertility levels (Sub)	2	0.02087*	0.10398*	0.03657*
Cropping System (M ₁) x Fertility levels (Sub)	4	0.00062	0.01405	0.000214
Varieties (M ₂) x Fertility levels (Sub)	4	0.000094	0.01213	0.001714
M ₁ x M ₂ x Sub	8	0.000502	0.01911	0.000278
Error (Sub)	36	0.000375	0.01155	0.000127

* Significant at 5 per cent Probability

Appendix-XLIII

Analysis of variance for nitrogen uptake (kg ha⁻¹) by different plant parts at harvest

Source of Variation	d.f.	Mean Sum of Square					
		Month of observation					
		1998-2000			1999-2001		
		Cane	Greentop	Trash	Cane	Greentop	Trash
Replication	2	373.827	0.377	17.736	93.367	1.596	0.111
Cropping System (M ₁)	2	498.098*	6.484*	21.670*	460.596*	5.168*	17.785*
Varieties (M ₂)	2	127.718*	1.046*	9.349*	117.101*	0.807*	8.237*
Cropping System (M ₁) X Varieties (M ₂)	4	3.918	45.977	0.219	3.655	0.0006	0.173
Error (Main)	16	8.924	0.118	0.158	2.211	0.014	0.056
Fertility levels (Sub)	2	111.945*	1.288*	9.252*	110.483*	1.058*	8.471*
Cropping System (M ₁) x Fertility levels (Sub)	4	3.405	0.001	0.196	3.057	0.005	0.195
Varieties (M ₂) x Fertility levels (Sub)	4	0.566	0.017	0.061	1.002	0.007	0.060
M ₁ x M ₂ x Sub	8	0.987	0.005	0.031	0.705	0.005	0.022
Error (Sub)	36	2.261	0.043	0.096	2.565	0.008	0.039

* Significant at 5 per cent Probability

XLIX

Analysis of variance for residual nitrogen, phosphorus and potassium (kg ha⁻¹)

Source of Variation	d.f.	Mean Sum of Square					
		Month of observation					
		1998-2000			1999-2001		
		Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
Replication	2	34.8	1.8	41.3	4.7	0.6	66.9
Cropping System (M_1)	2	544.3	41.9	1125.5	466.8	36.2	848.7
Varieties (M_2)	2	1549.6	37.5	2554.5	1546.9	42.3	2463.3
Cropping System (M_1) X Varieties (M_2)	4	1.6	0.03	3.7	1.5	0.2	14.2
Error (Main)	16	70.7	3.2	66.6	40.2	2.7	61.3
Fertility levels (Sub)	2	1482.1	218.8	1325.6	1406.0	232.9	1468.9
Cropping System (M_1) x Fertility levels (Sub)	4	0.1	0.1	0.7	1.1	0.2	1.0
Varieties (M_2) x Fertility levels (Sub)	4	9.7	0.9	63.6	14.6	1.2	30.1
M_1 x M_2 x Sub	8	0.9	0.1	3.5	27.1	0.6	2.7
Error (Sub)	36	153.8	5.1	198.6	150.2	9.6	156.7

* Significant at 5 per cent Probability

V I T A

The author, Sarnam Singh, was born on 7th July, 1972 in Distt, Lakhimpur-Kheri.. He passed his High School and Intermediate examination from K.S.I. College, Gola Gokarannath. Thereafter, he admitted in the Purvanchal University, Jaunpur (U.P.) in 1991 for B.Sc. Ag. degree programme and completed this degree in July 1995. Later, he got admitted in Allahabad Agricultural Institute (Deemed University), Allahabad in 1995 as a student of M.Sc. Ag. with major in Agronomy.

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ABSTRACT

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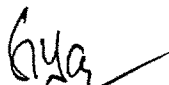
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Thesis Title: "Nutritional requirement of sugarcane genotypes under different cropping systems".

A field experiment on "Nutritional requirement of sugarcane genotypes under different cropping systems" was conducted at the Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Udham Singh Nagar) from October, 1998 to March, 2001.

The experiment consisted of three cropping systems viz: autumn + mustard, mustard- spring and wheat - late spring sugarcane; three genotypes viz: CoPant 90223, CoPant 92226 and CoPant 93227 and three fertility levels viz: 75, 100 and 125 per cent of the recommended NPK. The experiment was laid out in split plot design keeping cropping systems and genotypes in main plots and fertility levels in sub-plots with three replications.

The findings of the investigation indicated that autumn sugarcane intercropped with mustard produced significantly higher cane yield than that of spring and late spring planted sugarcane crop following mustard and wheat crops. Genotype, CoPant 93227 performed better than CoPant 90223 and CoPant 92226 with respect to cane yield. However, CoPant 92226 performed better in relation to juice quality. Application of 125 per cent of the recommended NPK produced significantly higher cane yield and yield attributes than that of 75 and 100 per cent of the recommended NPK levels. Interaction between cropping systems and genotypes affected that under autumn sugarcane inter cropping system, CoPant 93227 produced significantly higher cane yield (103.8 and 86.0 tha^{-1}) than CoPant 90223. Under mustard - spring and wheat - late spring cropping systems all varieties performed similar.


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