EFFECT OF MOISTURE REGIMES, SUCCERICIIDE AND WEEDICIDES ON GROWTH, YIELD AND QUALITY OF RUSTICA TOBACCO (Nicotiana rustica L.) cv. GC 2

A THESIS SUBMITTED TO THE GUJARAT AGRICULTURAL UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF Doctor of Philosophy (AGRICULTURE) IN AGRONOMY

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1995

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ABSTRACT
ABSTRACT

A field experiment was conducted under middle Gujarat agro-climatic conditions, at the Bidi Tobacco Research Station, G.A.U., Anand, during 1993-94 and 1994-95 with a view to study the effect of moisture regimes, suckercide and weedicides on growth, yield and quality of rustica tobacco cv. GC 2.

The experiment comprised combinations of three levels of irrigation based on IW/CPE ratio (0.7, 1.1 and 1.5) and two treatments of sucker control (hand desuckering and pendimethalin 0.75 per cent) along with five treatments of weed control (local practice, fluchloralin 1.0 and 1.5 lit/ha, pendimethalin 1.0 and 1.5 lit/ha). The experiment was laid out in a split plot design with four replications, wherein irrigation and suckercide treatments
were embedded in the main plots, while weed control treatments were assigned to the sub plots.

The results revealed that irrigation schedule based on IW/CPE ratio of 1.1 markedly increased plant height, leaf length and leaf width. IW/CPE ratio of 1.1 gave significantly higher cured leaf yield as compared to 0.7 and 1.5 ratios. Similarly, the spangle and growth scores were also higher under the same ratio. It is also observed that with increasing levels of irrigation the fresh weight of suckers, dry weight of weeds and orobanche weight were increased.

The fresh weight of suckers, dry weight of weeds and orobanche weight were significantly higher under 1.5 IW/CPE ratio as compared to 0.7 and 1.1 IW/CPE ratios.

The field water use efficiency decreased with increase in IW/CPE ratio from 0.7 to 1.5. The IW/CPE ratio of 1.1 was found to be an optimum ratio from growth and yield attributes view points. It also gave highest net realization of Rs. 15291/ha and CBR of 1:2.06. Although increase in irrigation frequency significantly decreased both total-N and leaf nicotine contents, the differences were not large to cause drastic change in the leaf quality.

Application of pendimethalin @ 0.75 per cent in the leaf axil significantly improved yield and yield
attributing (leaf length, width and growth score) characters as well as spangle score, a quality trait over hand desuckering. The increase in cured leaf yield was to the tune of 8.36 per cent under chemical desuckering over hand desuckering.

The increase in yield was achieved due to reduction in the sucker weight. The reduction in sucker weight under S2 was to the extent of 7.32 per cent over hand desuckering. The reduction trend in dry weights of weeds and orobanche was also observed under pendimethalin application. The field water use efficiency was higher under the application of pendimethalin. Application of pendimethalin also accrued higher net return (Rs. 13022/ha) than hand desuckering (Rs. 11170/ha).

Suckericidal treatment significantly decreased total-N, while nicotine content was increased, indicating improvement in the leaf quality over hand desuckering.

The application of weedicide was significant in almost all attributes studied during the course of investigation, wherein application of fluchloralin @ 1.5 lit/ha gave significant improvement over local practice except fresh weight of suckers, orobanche weight as well as spangle and growth scores which were not significantly influenced by different weedicide treatments. The application of fluchloralin @ 1.5 lit/ha also significantly
decreased the dry weight of weeds as compared to the local practice of weed management. The higher field water use efficiency was also observed under the treatment of fluchloralin @ 1.5 lit/ha than other treatments.

Application of fluchloralin @ 1.5 lit/ha fetched the highest net realization (Rs. 14965/ha) and gave maximum CBR (1:1.99).

The chemical quality parameter viz., total-N and nicotine contents of leaf lamina were significantly decreased due to the application of weedicide over local practice. However, the variation was not large enough to cause drastic changes in the leaf quality.

The interaction effect I x S exhibited significant effect on leaf width, wherein I2S2 treatment combination registered the highest values. Similarly, interactions I x W, I x S, S x W and I x S x W exhibited significant influence on dry weight of weeds, where I1W3, I1S2, S2W3 and I1S1W3 registered lower dry weight of weeds.

From the foregoing results it is pertinent that rustica tobacco variety GC 2 gave highest cured leaf yield as well as net returns when it was irrigated at 1.1 IW/CPE ratio (10 to 11 irrigation of 50 mm depth), chemically desuckered with 0.75 per cent pendimethalin and weed managed by application of fluchloralin @ 1.5 lit/ha along with irrigation under middle Gujarat agroclimatic conditions.
CERTIFICATE

This is to certify that the thesis entitled
EFFECT OF MOISTURE REGIMES, SUCKERICIDE AND
WEEDICIDES ON GROWTH, YIELD AND QUALITY OF RUSTICA
TOBACCO (Nicotiana rustica L.) cv. GC 2 submitted by
Shri Shivabhai Ragh Nathbhai Chaudhari in partial
fulfilment of the requirement for the award of the degree
of DOCTOR OF PHILOSOPHY (Agriculture) in AGRONOMY of the
Gujarat Agricultural University is a record of bonafide
research work carried out by him under my guidance and
supervision and the thesis has not previously formed the
basis for the award of any degree, diploma or other similar
title.

Anand
January 5th, 1996

(P. N. Upadhyay)
Major Advisor
ACKNOWLEDGMENT

With immense pleasure and great privilege, I take this opportunity to express my deep sense of gratitude to my Major Advisor, Dr. P.N. Upadhyay, Professor and Head, Department of Agronomy, B.A. College of Agriculture, Gujarat Agricultural University, Anand Campus, Anand for his keen interest, valuable guidance, constant encouragements throughout the course of investigation and the preparation of this manuscript.

I heartily express my sincere thanks to the members of my Advisory Committee Dr. K.I. Joshi, Associate Professor of Horticulture, B.A.C.A., Anand Dr. R. B. Patel, Professor and Head, Department of Agronomy, G.A.U. S.K. Nagar and Dr. N.M. Patel, Principal, B.A. College of Agriculture, Anand for their valuable suggestions and constructive criticism during the course of my research programme.

I am highly thankful to the Agriculture and Rural Development Department, Government of Gujarat, Sachivalaya, Gandhinagar and Director of Agriculture, Gujarat State, Ahmedabad for deputing me for higher study leading to Ph.D. degree under the post-graduate study programme.
I am equally thankful to the Director of Campus, Gujarat Agricultural University, Anand Campus, Anand, the Principal, B.A. College of Agriculture, Anand, Project Co-ordinator (Tobacco) and Officer-in-charge (Tobacco), Gujarat Agricultural University, Anand for providing the necessary facilities during the course of this investigation.


My special thanks also due to the Farm Manager and Staff members of B.T.R.S. Farm for rendering their help during the field investigation and the staff member of Chemistry and Technology Section, B.T.R.S. for their cooperation during chemical analysis.

I am extremely thankful to the staff members of Agronomy Department, Sarvashri Prof. T.N. Barevadia, R.H. Patel, R.B. Patel, M.B. Patel and J.R. Patel and staff members of B.T.R.S. Sarvashri J.S. Patel, M.R. Patel and J.C. Chavda for their help in many ways during my study period.
I express my sincere thanks to the staff members of Computer Centre, G.A.U., Anand Sarvashtri Dr. P.R. Vaishnav, V.B. Darji, B. K. Bhatt, U.J. Upadhyay and Hitesh Bhatt for their timely help in statistical analysis of my research data.

I would find no words to express my heartfelt gratitudes, love and affection to my loving parents for their moral support throughout the period of my study.

I reserve my high appreciation and thanks to my wife Smt. Anjana and son Ronak and daughter Himadri for their patience, personal sacrifices, continued encouragement and keenness during the period of my study.

Lastly, I thank Bharatbhai for his timely help in respect of excellent typing of this manuscript.

Anand
November 19, 1995

( S. R. CHAUDHARI)
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INTRODUCTION
In Indian agricultural scenario, tobacco occupies a unique position though the area under this crop is hardly 0.23 per cent (4.17 lakh ha) of the total cropped area. India ranks third in world tobacco production and eighth in export, earning about Rs. 508 crores of foreign exchange and Rs. 2695 crores as excise revenue with an employment potential of nearly 50-60 lakh people (Anon., 1994).

In India, almost all types of tobaccos are grown except Oriental. They are classified into two major groups viz., flue-cured virginia (FCV) and non-virginia. *Nicotiana rustica* falls under non-virginia type, which is mainly grown in north-eastern states (Uttar Pradesh, Bihar and West Bengal), Gujarat and Maharashtra and mainly used for hookah, chewing and snuff purposes. Although separate statistics are not available for this tobacco, it finds place in the export on account of high nicotine content of leaf.

In Gujarat, four types of tobaccos are grown viz., bidi, chewing (lal and kala chopadia), gadaku and culcutti (*N. rustica*) in an area of about 105.5 thousand hectares, wherein rustica is grown in about 15 to 20 thousand hectares in middle (Kheda) and north (Mehsana, Banaskantha, Sabarkantha and Gandhinagar districts) Gujarat regions.
Although this type has very good export potential besides domestic use, enough efforts are not made to improve the yield and quality through agronomic manipulations.

This being a rabi crop, its irrigation requirement is very high however, judicious application may help in improving yield and quality with economising water. The work carried out at the Bidi Tobacco Research Station (BTRS), Anand based on the climatological approach has indicated that irrigating crop at 1.1 IW/CPE ratio was found economical for GC 1 variety (Patel et al., 1992 b).

Irrigation coupled with adequate supply of nitrogen improves vegetative growth, which not only gives higher yield but increases sucker growth profusely. Therefore, the management of suckers (axillary growth) is an important operation for diverting the photosynthates to the leaf sink for increasing yield and improving the leaf quality. Researches carried out in India have indicated that several contact suckericides viz., pendimethalin, decanol, neem oil etc. are found advantageous and economical (Chavda et al., 1991 and Patel et al., 1992 a).

Besides irrigation and sucker management, weed control is also a crucial operation as weeds are reported to reduce tobacco yield by about 57 % (Raghavaiah et al., 1980). Dimeska and Stojkov (1987) and Kalinova (1989) have reported that pre-plant incorporation of pendimethalin,
fluchloralin and other weedicides had effectively managed weeds in tobacco fields. However, application of weedicides at later stages of growth had not been tried. The weed free condition at the time of harvest facilitates quick drying of tobacco left on the ground. However, attempts have not been made to control weeds at later stages of crop growth.

Informations on above aspects are not available especially for GC 2, an improved variety of rustica tobacco over GC 1, which gives about 20 per cent higher yield than the latter (Anon., 1994). Therefore, present the investigation was carried out at the Bidi Tobacco Research Station (BTRS), Gujarat Agricultural University, Anand to study the effect of moisture regimes, suckericide and weedicides on growth, yield and chemical composition of GC 2 with the following specific objectives:

1. To find out an optimum level of irrigation with regard to yield and quality.

2. To evaluate the efficacy of pendimethalin as a sucker control agent.

3. To evaluate the effect of different doses of herbicides on weed control, yield and quality of rustica tobacco.

4. To find out the influence of irrigation, suckericide and weedicides on chemical composition of leaf.

5. To work out the economics of irrigation, suckericide and weedicide levels.
REVIEW
OF
LITERATURE
II REVIEW OF LITERATURE

There have been continuous attempts to generate information on irrigation requirement, suckercide and weedicides to augment tobacco yield in different tobacco growing regions of India. Efforts are, therefore, made to present in this chapter a brief review of studies carried out at several places, more or less related to the present investigation. The review has been highlighted in respect of the following aspects.

2.1 Effect of moisture regimes
   2.1.1 Cured leaf yield and yield attributes
   2.1.2 Chemical composition

2.2 Effect of suckercide
   2.2.1 Cured leaf yield and yield attributes
   2.2.2 Chemical composition

2.3 Effect of different weedicides
   2.3.1 Cured leaf yield and yield attributes
   2.3.2 Chemical composition

2.4 Residual effect of different weedicides on succeeding crop

2.1 EFFECT OF MOISTURE REGIMES

The key to increase production and productivity of tobacco is the management practices, which include selection of better varieties, adoption of appropriate cultural practices viz., irrigation, fertilizer application,
spacing, topping etc. and plant protection measures. Among these, irrigation alone can boost up the yield by more than two folds (Sinha et al., 1982). Gopalachari and Gopinath (1965) reported progressive increase in yield of FCV tobacco with increase in irrigation. One and two irrigations increased yield of FCV tobacco by 16 and 31 per cent, respectively (Kadam et al., 1955). Walunjkar and Singh (1967) also reported 21 per cent increase in yield over no irrigation. Khot (1974) observed 21 and 29 per cent increase in tobacco yield with one and two irrigations at active growth stage of the crop, respectively.

The irrigation practice in vogue is to flood the crop as and when it shows visual symptoms of wilting. This involves huge wastage of irrigation water. A substantial improvement in water use efficiency would perhaps be possible by scheduling the irrigation according to plant development stages and based on open pan evaporation. Ravindranath and Subrahmanyam (1978) indicated that frequent irrigations (12 times) during crop season, as in farmers' method, resulted in lower yields as well as less per cent of commercially acceptable tobacco. They also reported that irrigating the crop based on open pan evaporation resulted in more yield in comparison to irrigating the crop based on intermittent stress.
2.1.1 Cured leaf yield and yield attributes

Mehrotra et al. (1970) conducted a field experiment on hookah tobacco (*N. rustica*) cv. NPS 219 with four soil moisture treatments (75, 50 and 25 per cent ASM as well as wilting range i.e. no irrigation after crop establishment) at the Institute of Agricultural Sciences, Kanpur (Uttar Pradesh). They reported that tobacco plants raised at 50 per cent available soil moisture gave the best growth in terms of plant height, number of leaves and leaf area and thereby higher cured leaf yield. Soil moisture above or below 50 per cent level reduced the growth characters. The crop raised in wilting range showed the poorest growth.

The irrigation experiment was conducted on bidi tobacco at Anand to study the influence of irrigation practices on yield and management of orobanche (Khot, 1974). The results revealed that irrigating the crop as and when required, which received about six irrigations gave more than 50 per cent increase in yield compared to unirrigated plots (no irrigation after crop establishment). The increase in yield was attributed to enormous increase in leaf size.

Ravindranath and Subrahmanyam (1978) carried out a field trial on flue-cured tobacco (FCV) at ILTD Research Department, Rajahmundry (Andhra Pradesh) to observe the effect of different methods (farmers' practice, intermittent
stress and evaporimetry) of irrigation. They observed that irrigating crop as per farmers' method, which received twelve irrigations during the crop season gave lowest yield. But there was little difference in yield of tobacco produced by practicing the other two methods viz., intermittent stress and evaporimetry methods, wherein the number of irrigations were 8 and 6, respectively.

Sannibabu and Reddy (1981) conducted an experiment on FCV tobacco at Devarapalli Farm of CTRI, Rajahmundry (Andhra Pradesh) for evaluating the efficacy of the sprinkler system of irrigation on the yield and quality of tobacco. They reported that partial sprinkler and furrow irrigation produced more green leaf, cured leaf, bright leaf and cured to bright leaf recovery than complete sprinkler irrigation and surface as well as furrow system. Ramachandram et al. (1984) conducted experiment under similar condition to study the influence of individual IW/CPE ratios (0.5, 0.75 and 1.0) and mixed ratios (0.5 + 1.0 + 0.75) and found that mixed IW/CPE ratios of 0.50 from 0 to 45 days after planting (DAP), 1.0 from 45 to 75 DAP and 0.75 from 75 DAP till harvest was superior to other irrigation schedules from leaf production and quality view points.

Singh et al. (1981) studied the effect of four irrigation levels on yield (no irrigation, one irrigation,
two irrigations and three irrigations) and quality of chewing tobacco at CTRI Research Station, Pusa (Bihar). They observed that irrigating chewing tobacco at all the three stages (establishment, topping as well as development and maturation stages) at monthly interval (October, November and December) recorded highest cured and first grade leaf yields. From another experiment, Sinha et al. (1982) reported 2.5 fold increase in yield and 3 fold increase in realization from irrigated tobacco compared to rainfed.

With a view to study the effect of soil moisture regimes on total and first grade leaf yields and economics of cigar wrapper tobacco, an experiment was conducted at the CTRI Research Station, Dinhata (West Bengal) during 1975-76 to 1976-77. The results indicated that the total cured leaf and first grade leaf yields obtained under 60 per cent available soil moisture (ASM) regime had surpassed the yields recorded under control and irrigations at 20, 40 and 80 per cent ASM (Tripathi and Bhattacharya, 1981). The experiment conducted on Motihari tobacco at the same location indicated that crop irrigated at 40, 60 and 80 per cent ASM gave almost identical yields but all three were significantly superior to no irrigation treatment (Anon., 1988-89 a).
An experiment was conducted by Sinha et al. (1985) on sandy loam calcareous soil of the CTRI Research Station, Pusa (Bihar), involving four treatments of irrigation (0, 1, 2 and 3) given to the chewing tobacco cv. DP 401. The results revealed that levels of preceding irrigation influenced significantly plant height, weight of root and stem of ratoon crop, but they failed to influence the leaf weight. Two and three irrigations were at par, but recorded significantly higher yield than no irrigation.

The irrigation experiment involving five IW/CPE ratios (1.5, 1.3, 1.1, 0.9 and 0.7) was conducted at BTRS, Anand (Gujarat) on GC 1, a rustica tobacco variety. The results revealed that irrigating crop at 1.1 IW/CPE ratio (I3) produced significantly higher yield over 0.9 (I4) and 0.7 (I5), but it was at par with 1.5 (I1) and 1.3 (I2) IW/CPE ratios (Anon., 1988-89 b). However, an experiment conducted on bidi tobacco variety GT 5 revealed that though yields obtained under 0.4, 0.5, 0.6 and 0.7 IW/CPE ratios were non-significant, they were significantly superior than irrigation given upto crop establishment (no irrigation) and 0.3 IW/CPE ratio (Anon., 1988-89 c). From another experiment (no irrigation, irrigation upto crop establishment, 0.3, 0.5 and 0.7 IW/CPE ratios) on bidi tobacco cv. A 119, Patel et al. (1993) reported that 0.5 IW/CPE ratio i.e. four irrigations at about 20 to 25 days interval gave the highest yield.
Irrigation experiment conducted in clay loam soils of the Agricultural Research Station, Nipani (Karnataka) on bidi tobacco cv. NPN 190 by Khot et al. (1989), showed that crop irrigated at 65, 85, 105 and 125 days (four irrigations) after planting gave significantly higher yield over no irrigation and one and two irrigations. They concluded that if irrigation water is inadequate, crop should be irrigated at the earlier stages and it could be skipped at later stages.

An experiment was conducted at BTRS, Anand to study the irrigation requirement of bidi tobacco cv. GT 5 under rainfed condition. Four irrigation levels viz., no irrigation (I1), irrigation up to crop establishment (I2), 0.3 IW/CPE ratio (I3) and 0.6 IW/CPE ratio (I4) were tried. They reported that levels of irrigation differed significantly for cured leaf yield as well as other attributes, wherein I4 showed its significant superiority over others for cured leaf yield and growth score. But spangle score, leaf width and plant height under I4 were at par with I3 (Anon., 1990-91 a).

Effect of irrigation schedule (1.5, 1.3, 1.1, 0.9 and 0.7 IW/CPE ratios and traditional basin irrigation at 10-12 days interval) was studied on hookah tobacco (N. rustica) cv. ST 1 at Saraimiran (Uttar Pradesh). Among different ratios, 1.1 IW/CPE ratio out yielded all the
ratios but was at par with traditional method of irrigation (Anon., 1990-91b).

2.1.2 Chemical composition

Mehrotra et al. (1970) reported that, maximum total nitrogen and nicotine per cent were found in the plants raised under 50 per cent available soil moisture level, which was closely followed by 25 and 75 per cent available soil moisture. The tobacco plants grown under severe moisture stress i.e. in the wilting range showed the least values for these constituents.

Tripathi and Bhattacharya (1983) reported progressive decrease in nicotine, total-N and protein-N of cigar wrapper tobacco leaf with increase in soil moisture regimes from 0 to 80 per cent ASM.

The effect of different irrigation schedules on the chemical and physical quality characteristics of FCV tobacco was studied by Ramachandram et al. (1984). They found that irrigating tobacco with 200 mm water on the basis of mixed IW/CPE ratio of 0.5 from planting to 45 days, 1.0 from 45 days to 75 days and 0.75 from 75 days after planting to final harvest gave good quality leaf with comparatively lower nitrogen and nicotine contents, higher reducing sugars and reasonably low chloride content with better quality ratios than the other irrigation schedules.
Sinha et al. (1985) observed higher nicotine content in transplanted and ratoon crops of chewing tobacco with two irrigations than 0, 1 and 3 irrigations.

The irrigation experiment on rustica tobacco cv. GC 1 conducted at BTRS, Anand revealed that irrigation schedules significantly affected both total-N and nicotine contents. Nitrogen content was significantly higher in 1.1 IW/CPE ratio as compared to 1.3 and 1.5 IW/CPE ratios, but rest (0.9 and 0.7 IW/CPE ratios) were at par. Nicotine content was significantly higher in 0.7 IW/CPE ratio than 1.3 IW/CPE ratio but rest were at par (Patel et al., 1992 b).

While working with bidi tobacco cv. A 119 at BTRS, Anand, Patel et al. (1993) found that 0.5 IW/CPE ratio gave significantly higher nicotine content than 0.3 or 0.7 IW/CPE ratio. Though chloride content was significant, it was less than 2 per cent in all the irrigation treatments.

2.2 EFFECT OF SUCKERICIDES

2.2.1 Cured leaf yield and yield attributes

When tobacco is topped, axillary growth is promoted, which is known as suckers. The growth of suckers is due to inhibition of a hormone (auxin) that is present in the shoot apex (Elliot and Court, 1978). This axillary growth competes with normal leaf for photosynthates, soil moisture and nutrients (Tripathi and Bhattacharya, 1985)
and thereby decreases yield and deteriorates quality of tobacco leaves. Hence, sucker growth must be checked to maximise leaf weight and quality. The process of removing suckers by hand is costly and laborious (Gaines 1959) and also shares about 6 to 8 per cent of the cost of bidi tobacco production (Patel et al., 1978). It is, therefore, essential to check the growth of suckers through chemicals.

Patel et al. (1978) conducted an experiment on bidi tobacco cv. A 119 with three (AC 92, 390, AC 92, 553 (Now ACCOTAB) and TC Chemical) contact suckericides at three different concentrations (first two at 175, 262.5 and 350 mg a.i. plant⁻¹ and TC at 15, 20 and 25 L ha⁻¹ in 300 L of spray solution) along with hand desuckering (control) at BTRS, Anand (Gujarat). They reported that both AC suckericides at all the concentrations proved significantly effective in reducing the number and weight of axillary as well as ground suckers as compared to control and TC chemical. The AC 92, 553 suckercide at low, medium and high levels controlled axillary and ground suckers to the extent of 93.7, 97.3 and 94.1 as well as 75.5, 81.9 and 84.2 per cent, respectively. They have also observed that both AC suckericides had produced higher cured leaf yield than control and TC chemical, but differences among treatments were not significant.
Bangarayya et al. (1982) studied the effect of non-edible oils (neem, karinja, mohua, tobacco seed oil and SA 40 (mineral oil) each at 5, 10 and 20 per cent and groundnut oil at 5, 15 and 25 per cent applied @ 4 mL/plant as well as Ac 92 compound at dilution of 19.0, 15.2 and 11.5/mL and G and G oil at dilution of 1:20 and 1:30 applied @ 20 mL/plant as a coarse spray directed towards the tip of the top six internodes along with hand desuckering (practice in vogue) and topped and unsuckered (control) on suppression of suckers in FCV tobacco grown under TBS of Rajahmundry (Andhra Pradesh). They observed that all the desuckering treatments were found to be significantly superior by producing lower dry weight of suckers when compared with topped and unsuckered treatment. But when they were compared with manual desuckering, neem and mohua oils and AC 92 compound proved their superiority over karinja, SA 40, tobacco seed and groundnut oils by significantly decreasing the sucker growth. They have further observed that the AC 92 compound at the highest concentration produced higher cured leaf as well as TBLE yields, followed by mohua oil at 20 per cent. The lowest cured leaf yield and TBLE were recorded in the control (topped and unsuckered) treatment.

Bangarayya et al. (1988) carried out an experiment to study the effect of neem oil (5, 10 and 20 per cent) along with topped and hand desuckered and topped unsuckered (control) treatments on the suppression of suckers in FCV
tobacco. They noted that all the concentrations of neem oil were superior by producing significantly lower dry weight of suckers as compared to topped and unsuckered as well as topped and hand suckered treatments. They have also found that among different neem oil concentrations, neem oil at 10 per cent produced the highest cured leaf, bright grade and TBLE.

The effect of neem oil emulsion (10, 20, 30 and 40 per cent) was evaluated along with pendimethalin (Stomp 30 per cent EC) and hand desuckering (control) for the control of suckers in bidi tobacco cv. A 119 (Patel et al., 1990). The results showed that among different neem oil emulsions, 30 per cent concentration was most effective for the control of axillary suckers and produced the highest cured leaf yield. However, compared to pendimethalin, neem oil treatments were found to be inferior for the control of ground suckers and resulted in lower cured leaf yield.

Bhat et al. (1990) conducted an experiment on bidi tobacco cv. A 119 with three suckercide (sucker out at 5 and 10 per cent, neem oil at 17.5 and 35 per cent and pendimethalin at 0.75 and 1.5 per cent) along with hand desuckering under Nipani (Karnataka) conditions. Data revealed that neem oil at 35 per cent and pendimethalin at 1.5 per cent suppressed the suckers to the extent of 32.4
and 34.4 per cent and enhanced the yield of tobacco by 23.4 and 22.7 per cent, respectively over hand desuckering.

Janardhan et al. (1990) studied the effect of neem oil (15, 20, 25 and 35 per cent) and decanol (3, 4 and 5 per cent) on suppression of suckers in FCV cultivars (FCV Spl., Swarna, Bhavya and F 210) at Shimoga (Karnataka). They reported that decanol 3 to 5 per cent suppressed the growth of the suckers to the extent of 67-80 per cent, while neem oil reduced dry weight of suckers by 9-37 per cent over hand desuckering. The cured leaf, bright leaf and TABLE yields were increased by 3-6, 7-16 and 3-8 per cent with decanol, respectively over hand desuckering.

Chavda et al. (1991) carried out an experiment on bidi tobacco cv. A 119 to study the effect of decanol (4, 5, 6 and 7 per cent) vis-a-vis pendimethalin (0.75 per cent) and hand desuckering (control) on the reduction of sucker growth. The results indicated that decanol at 7 per cent and pendimethalin at 2.5 per cent reduced the weight of axillary suckers to the extent of 88 and 93 per cent and enhanced the yield by 13 and 18 per cent, respectively over hand desuckering. Similar trend was noticed in case of control of ground suckers and dry weight per unit area.

An experiment was conducted at the Bidi Tobacco Research Station, Anand to evaluate the effect of different
suckericides viz., off shoot 3 per cent, tamex 2 per cent, decanol 4 per cent, neem oil 40 per cent and accotab (stomp 2.5 per cent) for the control of suckers in bidi tobacco cv. A 119 (Patel et al., 1992a). They observed that tamex and stomp (Accotab) were found to be the most effective and superior over other treatments. Both the suckericidal treatments increased leaf dry weight per unit area which led to significant increase in cured leaf yield (15 per cent) over hand desuckering.

Rao et al. (1993) conducted an experiment at Tobacco sub-centre, Venkataramannagudem (Andhra Pradesh) for three seasons to evaluate the effect of suckericides on yield and quality of irrigated natu tobacco. They found that accotab (stomp 35 per cent EC) at 0.75 per cent concentration proved effective in obtaining higher cured leaf yield over other suckericidal treatments (neem oil 20 and 30 per cent, sucker out 3, 3.5 and 4 per cent), but it was on par with hand desuckering. The increase in yield under accotab treatment was by about 10.6 per cent over hand desuckering.

2.2.2 Chemical composition

Bangarayya et al. (1988) reported from their study on suckercide in FCV tobacco that the nicotine and reducing sugar contents were not significantly affected by any of the concentrations of neem oil but there was increase in
nicotine content and decrease in sugar content with increase in neem oil concentrations.

Patel et al. (1990) examined the influence of neem oil emulsion and pendimethalin as suckericides on bidi tobacco. They found that the nicotine and reducing sugars contents were not significantly affected by any of the concentrations of neem oil as well as pendimethalin indicating no deleterious effect of the chemical suckericides on the leaf quality. Patel et al. (1992 a) also reported similar findings.

Chavda et al. (1991) carried out an experiment on sucker control in bidi tobacco through decanol along with pendimethalin. They reported that decanol at 6 per cent and pendimethalin at 0.75 per cent significantly reduced the nicotine content in tobacco leaf as compared to hand desuckering. This might be due to dilution effect as yield was significantly increased under chemical sucker control treatments, while reducing sugar content was not altered significantly due to different treatments under investigation.

Rao et al. (1993) studied the effect of suckericides on yield and quality of irrigated natu tobacco. They reported that nicotine, chlorides and leaf burn were not significantly affected by any of the concentrations of suckericidal treatments indicating no harmful effect of chemical suckericides on the leaf quality.
2.3 EFFECT OF DIFFERENT WEEDICIDES

Among several factors affecting tobacco production, weed population is the key factor, which competes for space, light and nutrients. Intensive cropping system coupled with judicious use of inputs offers congenial environment for the growth and development of weeds. Though manual weeding is an effective method of controlling weeds, it is often considered to be laborious, unproductive in terms of resource use, requires frequent attention and is not always possible at the appropriate time. Thus, there is a growing need to employ alternative system of weeding, of which, use of weedicides offers immense potential.

2.3.1 Cured leaf yield and yield attributes

Sinha and Singh (1977) studied the influence of weedicides on occurrence and control of weeds in chewing tobacco in north Bihar. The results revealed that weedicides significantly reduced the weight of weeds. However, average yields under weedicide treatments [Bladex, Lorox, Tillam and EPTC (ethyldipropylthiocarbamate) @ 3 and 6 kg/ha] were significantly lower than hand weeding.

From the results of three years field study (1982-83 to 1984-85) carried out at Anand to find out weed control method in bidi tobacco cv. A 119, Mehta et al. (1985) reported the highest yield of cured leaf in hand
weeded plots, which was similar to that obtained with 1.5 kg/ha fluchloralin, 0.75 kg/ha benthiocarb (thiobencarb) or 0.1 kg/ha oxyfluorfen + four interculturing.

Weed control in irrigated bidi tobacco with pre-planting incorporated herbicides (fluchloralin, diphenamid, alachlor and pebulate) was studied by Palled et al. (1985) at Dharwad (Karnataka). They observed that fluchloralin at 2 kg/ha gave significantly higher cured leaf yield than hoeing and was equal to that of weed free condition.

Raghavaiah et al. (1985) conducted a field experiment on light soils of Devarapalli (Andhra Pradesh) to study the effect of herbicide mixtures on the yield, chemical and physical quality characteristics of FCV tobacco. Different weedicides viz., diphenamid, trifluralin, nitralin, alachlor, fluchloralin and chloramben were tried individually and in combinations. The results revealed that the cured leaf yield was the highest in the treatment with diphenamid 4 kg a.i./ha + alachlor 1 kg a.i./ha, followed by hand-weeded check, diphenamid 4 kg a.i./ha + chloramben 1 kg/ha and diphenamid 4 kg a.i./ha + fluchloralin 1 kg a.i./ha, which were on par with each other.

Krishnamurthy (1986) conducted an experiment on chewing tobacco at Vedasandur (Tamil Nadu) and reported that weed control with 2 L/ha fluchloralin and especially
0.5 L/ha oxyflourfen increased leaf yields and net returns compared to manual weed control.

The effect of different weedicides application was evaluated at the Burley Tobacco Research Station, Jeddangi (Andhra Pradesh) during 1981 and 1982. It was observed that application of diphenamid at 4 kg/ha + oxyflourfen at 0.125 kg/ha effectively controlled the major weeds and produced tobacco yields which were equal to those of hand weeded plots. Diphenamid at 4 kg/ha + fluchloralin at 1.0 kg/ha had also produced significantly higher cured leaf yield than other weedicide treatments (Raghavaiah and Subbarao, 1986).

Dimeska and Stojkov (1987) reported that in transplanted tobacco, 1.5 L/ha goal (Oxyflourfen) and 8 and 10 L/ha stomp (pendimethalin) were most effective treatments, which increased tobacco yields by 23-24, 28-123 and 15-74 per cent and raised gross income by 12-28, 64-151 and 35-95 per cent in 1985, 1986 and 1987, respectively over control.

Kalinova (1989) from a field trial found that a single hoeing combined with pre-plant incorporated pendimethalin (990 g/ha) and other weedicides gave good control of weeds. Yields of tobacco were higher with these treatments than those obtained with no hoeing and equal to those with three hoeings.
Raghavaiah and Sannibabu (1991) conducted experiment to study the effect of diphenamid, trifluralin, nitralin, fluchloralin and alachlor alone and in various combinations on weed control efficiency and the yield of FCV tobacco at Devarapalli (Andhra Pradesh). They observed that herbicide treatments gave tobacco yields similar to those obtained under manual weeding.

A field experiment was conducted at CTRI Research Station, Vedasandur (Tamil Nadu) to study the effect of pre-emergence herbicides on weed control and yield of chewing tobacco by Krishnamurthy et al. (1991). They reported that pre-emergence application of the herbicides diphenamid, fluchloralin and oxyflourfen offered equal weed control efficiency and were comparable to hand weeded check in producing tobacco. Unweeded check plots gave the lowest yield, while diphenamid at 7.5 kg a.i./ha produced the highest yield.

2.3.2 Chemical composition

Raghavaiah et al. (1985) observed that leaf chlorides and nicotine were not significantly affected by the herbicidal treatments. But reducing sugar was significantly influenced by the herbicides. Reducing sugar to nicotine ratio was higher in leaves from hand weeded and unweeded checks than in leaves from herbicide treated plots.
Raghavaiah and Subbarao (1986) reported that leaves from hand weeded plots showed the highest leaf nicotine (1.3 per cent), while leaves from herbicide treated plots showed reduction in nicotine. Reducing sugar content was the highest in diphenamid 4 kg/ha + alachlor 1 kg/ha treated plot followed by alachlor at 1.5 kg/ha. But physical characteristics of leaves did not show significant variations due to different herbicidal treatments in comparison to hand weeding.

Various herbicides were evaluated for weed control in transplanted tobacco cv. Newdel at Delhi station of Ontario (Canada) by Zilkey and Capell (1985). They reported that yield, economic returns and chemical quality were not significantly affected by herbicide use.

2.4 RESIDUAL EFFECT OF DIFFERENT WEEDICIDES ON SUCCEEDING CROP

Lolas (1981) reported that different weedicides applied to preceding tobacco crop were not phytotoxic to succeeding oat crop.

However, Sisira et al. (1988) reported reduction in the root growth of wheat by about 54 per cent due to soil incorporation of pendimethalin (Stomp 33 per cent).
Raghavaiah and Krishnamurthy (1986) carried out bioassay test using sunnhemp, groundnut and sesame as test crops succeeding to tobacco nursery treated with diphenamid, trifluralin, nitralin, chloramben and fluchloralin weedicides. They did not find phytotoxic effect of above weedicides applied on crops succeeding to tobacco nursery on a sandy loam soil of Rajahmundry (Andhra Pradesh).

Damage to wheat cover crop and subsequent burley tobacco treated with 0.29 and 86 mg flumetralin/plant as a suckericide was evaluated in field trials in Tennessee (USA) by Shelby et al. (1990). The tobacco plots received either no herbicide or a pre-planting application of 1.7 kg pendimethalin/ha. Where no pendimethalin was applied wheat injury averaged at 14 and 58 per cent after application of low and high rates of flumetralin, respectively. Where pendimethalin was applied wheat injury levels were 48 and 70 per cent. Injury to wheat from pendimethalin alone was 17 per cent. The interaction between pendimethalin and flumetralin was synergistic. Injury to a subsequent tobacco crop from soil carry over was < 8 and 18 per cent where low and high doses of flumetralin, respectively had been used in the previous year. But pendimethalin alone had no soil carry over effect on tobacco.
MATERIALS
&
METHODS
III MATERIALS AND METHODS

The field experiment was conducted at the Bidi Tobacco Research Station (BTRS), Gujarat Agricultural University, Anand Campus, Anand during rabi season of the years 1993-94 and 1994-95 to study the effect of moisture regimes, suckercide and weedicides on the yield and quality of rustica tobacco cv. GC 2. The materials used and experimental techniques adopted in the present investigation are described in this chapter.

3.1 SOIL CHARACTERISTICS

The soil of experimental field was sandy loam in texture. It was alluvial in origin, deep, well drained and highly retentive of soil moisture. The depth of ground water table was more than ten metres. The soil was rated as poor in organic carbon and nitrogen, medium in available phosphorus and rich in available potassium status.

The soil samples from the experimental site were collected randomly from five spots at a depth of 0-30 cm and a composite sample was prepared to determine the physico-chemical properties of the soil (Table 3.1).
Table 3.1: Physico-chemical properties of the experimental site (0-30 cm soil depth)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Method of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mechanical composition</td>
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</tr>
<tr>
<td></td>
<td>I. Coarse sand (%)</td>
<td>International Pipette Method, Piper, 1950</td>
</tr>
<tr>
<td></td>
<td>II. Fine Sand (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III. Silt (%)</td>
<td></td>
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<tr>
<td></td>
<td>IV. Clay (%)</td>
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<tr>
<td></td>
<td>Textural class</td>
<td>Loamy sand</td>
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<td>2.</td>
<td>Chemical properties</td>
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<td></td>
<td>I. Soil pH (1:2.5 soil:water ratio)</td>
<td>7.9 pH meter (Jackson, 1973)</td>
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<tr>
<td></td>
<td>II. Organic carbon (%)</td>
<td>Walkley and Black Method (Jackson, 1973)</td>
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<tr>
<td></td>
<td>III. Total nitrogen (%)</td>
<td>Kjeldahl's Method (Jackson, 1973)</td>
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<td></td>
<td>IV. Available P2O5 (kg/ha)</td>
<td>Olsen's Method (Jackson, 1973)</td>
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<td></td>
<td>V. Available K2O (kg/ha)</td>
<td>Flame Photometric Method (Jackson, 1973)</td>
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<td>3.</td>
<td>Physical properties</td>
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</tr>
<tr>
<td></td>
<td>I. Field capacity (%)</td>
<td>Field Method (Piper, 1950)</td>
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<tr>
<td></td>
<td>II. Permanent wilting point (%)</td>
<td>Sunflower Method (Piper, 1950)</td>
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<td></td>
<td>III. Bulk density (g/cm³)</td>
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</tr>
</tbody>
</table>
3.2 CLIMATE AND WEATHER

Geographically, Anand is situated at 20°-35', north latitude, 72°-55' east longitude with an elevation of 45.11 metres above the mean sea level. The climate of this region is semi-arid and sub-tropical. Monsoon commences by the third week of June and retreats by middle of September with an average rainfall of 864.00 mm received entirely from the South-West monsoon currents. Timely and sufficient rainfall in the monsoon in Kheda district is uncertain. Partial failure of rains once in three or four years is very common. July and August are the months of heavy precipitation. Practically, there is no rainfall in winter and summer, almost in all parts of Gujarat state, except sporadic showers in rabi season. Temperature during the rainy season varies from 20 to 35°C. However, in the month of October, it rises as high as 36°C. It continues to decline from the beginning of November. Winter is moderate and it sets in the month of November and continues till the end of January. The lowest temperature is usually recorded in the month of January. Summer is hot and dry covering the months of April and May.

The observations on meteorological parameters for the period of investigation during 1993-94 and 1994-95 as recorded at the meteorological observatory of Gujarat Agricultural University, Anand Campus, Anand are presented.
in Tables 3.2 and 3.3 and graphically depicted in Fig. 3.1 and 3.2, respectively. Data on daily pan evaporation (PE) measured from USWB Class-A evaporimeter during experimental period are presented in Tables 3.4 and 3.5.

The infestation of tobacco mosaic and leaf curl viruses was observed at the initial stage of crop growth during first year (1993-94) of the experiment. The plant protection measures were taken by spraying monocrotophos (Monocil 30 EC) at the rate of 15 ml per 10 litres of water.
Table 3.2: Mean weekly weather parameters during the crop growth period of 1993-94

<table>
<thead>
<tr>
<th>Month and Year</th>
<th>Std. week</th>
<th>Dates</th>
<th>Rainfall (mm)</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Sun shine hours/day</th>
<th>Pan evaporation (mm)</th>
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<td>29-04</td>
<td>0.00</td>
<td>33.64</td>
<td>17.70</td>
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<td>34.57</td>
<td>17.46</td>
<td>82.08</td>
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<td>31.47</td>
<td>11.06</td>
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<td>14.24</td>
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<tr>
<td></td>
<td>52</td>
<td>24-31</td>
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<td>28.26</td>
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<td>87.09</td>
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Fig. 3.1 Mean weekly weather parameters during the crop growth period of 1993-94
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Fig. 3.2 Mean weekly weather parameters during the crop growth period of 1994-95
Table 3.4: Daily evaporation (mm) measured from USWB Class-A pan evaporimeter during crop season (1993-94)

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* Unseasonal rainfall of 21.2 mm and 0.60 mm was received on 11.1.94 and 12.1.94, respectively, hence it has been deducted from cumulative pan evaporation on those days.
**Table 3.5: Daily evaporation (mm) measured from USWB Class-A pan evaporimeter during crop season (1994-95)**

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* Unseasonal rainfall of 0.50 mm and 0.60 mm was received on 8.1.95 and 7.3.95 respectively, hence it has been deducted from cumulative pan evaporation on those days.
### cropping history of the experimental plot

The details of cropping history of the experimental plot are given in Table 3.6.

Table 3.6: Cropping history of the experimental plot

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</tr>
<tr>
<td>1991-92</td>
<td>Kharif</td>
<td>Sunnhemp as a green manure</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Seed crop of rustica tobacco</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1992-93</td>
<td>Kharif</td>
<td>Sunnhemp as a green manure</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Rustica tobacco</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1993-94</td>
<td>Kharif</td>
<td>Sunnhemp as a green manure</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Present experiment of rustica</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tobacco</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1994-95</td>
<td>Kharif</td>
<td>Sunnhemp as a green manure</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Present experiment of rustica</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tobacco</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
3.4 EXPERIMENTAL DETAILS

The details of the experiment are given below. The plan of lay out is depicted in Fig.3.3.

3.4.1 Details of lay out

1. Crop and variety: Rustica tobacco variety Gujarat culcutti 2 (GC 2)

2. Design of the experiment: Split plot

3. Number of replications: Four

4. Number of plots/replication: 30

5. Total number of plots: 120

6. Plot size:
   a) Gross: 4.8m x 3.6m = 17.28m²
   b) Net: 3.6m x 2.4m = 8.64m²

7. Spacing: 60cm x 60cm

8. Area of one replication: 578.4 m²
   (including channels)

9. Area of four replications: 2313.6 m²
   (including channels)

10. Total area of experiment: 2766.75 m²
    (including channels and roads)

3.4.2 Treatment details

Thirty treatment combinations involving three levels of irrigation, two treatments of sucker control and five treatments for weed control were included in this study. They are described below.
Design: Split Plot
Plot size: Gross: 4.8m x 3.6m
Net: 3.6m x 2.4m

Fig. 3.3: Layout plan of field experiment
I. Main plot treatments

a) Irrigation levels

i. Irrigation at 0.7 IW/CPE ratio (I1)

ii. Irrigation at 1.1 IW/CPE ratio (I2)

iii. Irrigation at 1.5 IW/CPE ratio (I3)

Depth of irrigation water : 50 mm

b) Suckercide

i. Hand desuckering (S1)

ii. Pendimethalin 0.75 % (stomp 30 EC) (S2)

II. Sub plot treatments

i. Local practice (Interculturing followed by weeding, till crop permits) (W1)

ii. Local practice + Fluchloralin 1.0 lit/ha (W2)

iii. Local practice + Fluchloralin 1.5 lit/ha (W3)

iv. Local practice + Pendimethalin 1.0 lit/ha (W4)

v. Local practice + Pendimethalin 1.5 lit/ha (W5)

3.4.3 Treatment combinations

There were thirty treatment combinations, the details are given on next page.

3.5 Varietal characteristics

In this investigation, Gujarat calcutti 2 (GC 2) tobacco was used. This variety was evolved by crossing GC 1 x Coker 1. GC 1 is an improved variety released in 1981, while Coker 1 is an exotic variety introduced from U.S.A. G.C. 2 variety was released in 1993 for general cultivation in rustica tobacco growing areas of middle Gujarat due to 30 per cent higher yield than GC 1 and acceptable leaf quality. The details of this variety are given in Table 3.7.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment combinations</th>
<th>Suckericide levels</th>
<th>Weedicides levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice</td>
</tr>
<tr>
<td>2.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>3.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>4.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>5.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
<tr>
<td>6.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice</td>
</tr>
<tr>
<td>7.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>8.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>9.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>10.</td>
<td>Irrigation at 0.7 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
<tr>
<td>11.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice</td>
</tr>
<tr>
<td>12.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>13.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>14.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>15.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
<tr>
<td>16.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice</td>
</tr>
<tr>
<td>17.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>18.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>19.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>20.</td>
<td>Irrigation at 1.1 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
<tr>
<td>21.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice</td>
</tr>
<tr>
<td>22.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>23.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>24.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>25.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Hand desuckering</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
<tr>
<td>26.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice</td>
</tr>
<tr>
<td>27.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.0 lit/ha</td>
</tr>
<tr>
<td>28.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Fluchloralin 1.5 lit/ha</td>
</tr>
<tr>
<td>29.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.0 lit/ha</td>
</tr>
<tr>
<td>30.</td>
<td>Irrigation at 1.5 IV/CPE ratio</td>
<td>Pendimethalin 0.75 %</td>
<td>Local practice + Pendimethalin 1.5 lit/ha</td>
</tr>
</tbody>
</table>
Table 3.7: Characteristics of Gujarat Culcatti 2

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Parents</td>
<td>GC 1 x Coker 1</td>
</tr>
<tr>
<td>2</td>
<td>Year of release in Gujarat</td>
<td>1993</td>
</tr>
<tr>
<td>3</td>
<td>Evolved at</td>
<td>Bidi Tobacco Research Station, Anand</td>
</tr>
<tr>
<td>4</td>
<td>Plant height</td>
<td>49 cm (topped)</td>
</tr>
<tr>
<td>5</td>
<td>No. of leaves per topped plant</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>Average length of internodes</td>
<td>2.8 cm</td>
</tr>
<tr>
<td>7</td>
<td>Nature of stem</td>
<td>Round thick</td>
</tr>
<tr>
<td>8</td>
<td>Suckering habit</td>
<td>Same as GC 1</td>
</tr>
<tr>
<td>9</td>
<td>Leaf size</td>
<td>Length: 25cm Width: 18cm</td>
</tr>
<tr>
<td>10</td>
<td>Suckering</td>
<td>Moderate</td>
</tr>
<tr>
<td>11</td>
<td>Surface</td>
<td>Hairy and Moderately shining</td>
</tr>
<tr>
<td>12</td>
<td>Colour</td>
<td>Unripe: Dark green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ripe: Light green</td>
</tr>
<tr>
<td>13</td>
<td>Leaf thickness</td>
<td>Same as GC 1</td>
</tr>
<tr>
<td>14</td>
<td>Gumminess</td>
<td>Moderate</td>
</tr>
<tr>
<td>15</td>
<td>Spangles</td>
<td>Moderate and raised</td>
</tr>
<tr>
<td>16</td>
<td>Inflorescence</td>
<td>Compact</td>
</tr>
<tr>
<td>17</td>
<td>Maturity in days</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Transplanting to harvesting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seed to seed</td>
<td>165</td>
</tr>
<tr>
<td>18</td>
<td>Agronomic feature</td>
<td>It is tall type with well distributed leaves</td>
</tr>
<tr>
<td>19</td>
<td>Quality of produce</td>
<td>The produce has light green colour with moderate degree of spangling. Its leaf Chemistry is comparable to GC 1.</td>
</tr>
<tr>
<td>20</td>
<td>Average cured leaf yield (kg/ha)</td>
<td>3512</td>
</tr>
</tbody>
</table>

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3.6 CULTURAL OPERATIONS

3.6.1 Preparation of land

The experimental field was cross cultivated with a tractor drawn cultivator when the soil came in Vapsa condition. Stubbles and weeds were collected, removed and finally the field was prepared for laying out an experiment.

3.6.2 Application of fertilizer

Nitrogen was applied in the form of ammonium sulphate at the rate of 200 kg/ha. Ninety per cent of total nitrogen was given before transplanting as a basal dose, the remaining 10 per cent was given as a top dressing 30 days after transplanting.

3.6.3 Transplanting

Six weeks old healthy seedlings of rustica tobacco GC 2 were selected for transplanting. During the first year of the experiment, transplanting was done on 23rd Nov. 1993, while in the second year transplanting was done on 15th Nov., 1994. In both the years, transplanting was done after irrigating the field. Gap filling was done eight days after transplanting during both the years.

3.6.4 Irrigation

The quantity of irrigation water in each experimental plot was measured with the help of Parshall
flume having 15 cm throat size installed near the field head. Two common irrigations each of 50 mm were given to all the plots at the time of transplanting and gap filling for getting a uniform plant stand. Differential irrigations as per treatment were scheduled according to IW/CPE ratios with fixed depth of 50 mm irrigation water.

Daily evaporation was recorded from USWB Class-A pan evaporimeter installed in the meteorological observatory. Cumulative pan evaporation was taken as the sum of daily evaporation. The required volume of water to each irrigation treatment was given using stop watch for a definite length of time, so as to cover the depth of irrigation water, when CPE values reached at 70.1, 45.4 and 33.3 mm for IW/CPE ratios of 0.7, 1.1 and 1.5, respectively. The irrigation dates, frequency of irrigation and quantity of water applied to different treatments are given in Table 3.8.

3.6.5 Interculturing and weeding

Interculturing and weeding operations were carried out till the crop permitted, then it was stopped and as per the treatments, the respective weedicide quantity required per plot was applied drop by drop in irrigation water at 70-75 days after transplanting of the crop.
Table 3.8: Details of irrigation dates, frequency of irrigation and quantity of water applied to different treatments

<table>
<thead>
<tr>
<th>IW/CPE ratios</th>
<th>Month</th>
<th>Dates of irrigation</th>
<th>Frequency of irrigation</th>
<th>Total quantity of water applied, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁ = 0.7 IW/CPE ratio</td>
<td>November 23</td>
<td>15, 23 - -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>December 1</td>
<td>23 16</td>
<td>7 29</td>
<td>7 8</td>
</tr>
<tr>
<td></td>
<td>January -</td>
<td>24 7 29</td>
<td>10 15</td>
<td>8 13</td>
</tr>
<tr>
<td></td>
<td>February -</td>
<td>10 15</td>
<td>8 13</td>
<td>10 15</td>
</tr>
<tr>
<td></td>
<td>March -</td>
<td>8 13</td>
<td>8 13</td>
<td>10 15</td>
</tr>
<tr>
<td>I₂ = 1.1 IW/CPE ratio</td>
<td>November 23</td>
<td>15, 23 - -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>December 1</td>
<td>15, 30 8, 22</td>
<td>6, 21</td>
<td>10 11</td>
</tr>
<tr>
<td></td>
<td>January -</td>
<td>23 6, 21</td>
<td>3,14 23 3,13 23</td>
<td>10 11</td>
</tr>
<tr>
<td></td>
<td>February -</td>
<td>3,14 23 3,13 23</td>
<td>10 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>March -</td>
<td>3,10 3,11</td>
<td>3,11</td>
<td>10 11</td>
</tr>
<tr>
<td>I₃ = 1.5 IW/CPE ratio</td>
<td>November 23</td>
<td>15, 23 - -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>December 1</td>
<td>11, 23 4,14 24</td>
<td>2,22 31 5,16 27</td>
<td>13 15</td>
</tr>
<tr>
<td></td>
<td>January -</td>
<td>2,22 31 5,16 27</td>
<td>13 15</td>
<td>650 750</td>
</tr>
<tr>
<td></td>
<td>February -</td>
<td>8,15 22 28 5,12 19 26</td>
<td>13 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>March -</td>
<td>6,10 4,10 14</td>
<td>13 15</td>
<td>650 750</td>
</tr>
</tbody>
</table>
3.6.6 Application of suckericide

The topping was carried out by retaining 18 leaves on the plant excluding lower 2-3 leaves. The application of pendimethalin (Stomp 30 per cent EC) at 0.75 per cent concentration was given at the rate of 5 and 10 ml solution for axil and ground applications, respectively. After application, hand desuckering was done as and when required in all the treatments except 52.

3.6.7 Application of weedicides

Pendimethalin (Stomp 30 per cent EC) Fluchloralin (Basalin 45 per cent EC) were given as per the treatment alongwith irrigation water at about 70-75 days after planting when interculturing was not possible.

3.6.8 Harvesting

The crop was harvested when majority of the leaves had spangled and their yellowing had commenced. Harvesting was completed in three rounds.

3.6.9 Calendar of operations

The cultural operations carried out from land preparation to harvesting of tobacco are given in Table 3.9.
Table 3.9: Calendar of operations carried out during the experimental period

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Operation</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First season</td>
</tr>
<tr>
<td>1</td>
<td>Tractor cultivations (Two)</td>
<td>18.11.93</td>
</tr>
<tr>
<td>2</td>
<td>Removal of stubbles and roots of previous crop</td>
<td>18.11.93</td>
</tr>
<tr>
<td>3</td>
<td>Planking</td>
<td>18.11.93</td>
</tr>
<tr>
<td>4</td>
<td>Lay out of the experiment</td>
<td>18.11.93</td>
</tr>
<tr>
<td>5</td>
<td>Application of basal fertilizer</td>
<td>18.11.93</td>
</tr>
<tr>
<td>6</td>
<td>Transplanting of seedlings with common irrigation</td>
<td>23.11.93</td>
</tr>
<tr>
<td>7</td>
<td>Gap filling (with common irrigation)</td>
<td>01.12.93</td>
</tr>
<tr>
<td>8</td>
<td>Rest irrigations</td>
<td>As per treatment</td>
</tr>
<tr>
<td>9</td>
<td>Interculturing</td>
<td>22.12.93</td>
</tr>
<tr>
<td>10</td>
<td>Top dressing with ammonium sulphate</td>
<td>23.12.93</td>
</tr>
<tr>
<td>11</td>
<td>Interculturing</td>
<td>16.01.94</td>
</tr>
<tr>
<td>12</td>
<td>Topping, desuckering and application of suckercide</td>
<td>20.01.94</td>
</tr>
<tr>
<td>13</td>
<td>Spraying of insecticide monocrotophos (Monocil 15 mL in 10 lit. of water)</td>
<td>29.01.94</td>
</tr>
<tr>
<td>14</td>
<td>Removal of Orobanche</td>
<td>29.01.94</td>
</tr>
<tr>
<td>15</td>
<td>Interculturing (last)</td>
<td>31.01.94</td>
</tr>
<tr>
<td>16</td>
<td>Application of weedicides alongwith irrigation (III treatment)</td>
<td>08.02.94</td>
</tr>
<tr>
<td>17</td>
<td>Desuckering</td>
<td>09.02.94</td>
</tr>
<tr>
<td>18</td>
<td>Application of weedicides alongwith irrigation (I2 treatment)</td>
<td>10.02.94</td>
</tr>
<tr>
<td>19</td>
<td>Application of weedicides alongwith irrigation (I1 treatments)</td>
<td>14.02.94</td>
</tr>
<tr>
<td>20</td>
<td>Removal of Orobanche</td>
<td>15.02.94</td>
</tr>
<tr>
<td>21</td>
<td>Removal of Orobanche</td>
<td>22.02.94</td>
</tr>
<tr>
<td>22</td>
<td>Desuckering</td>
<td>23.02.94</td>
</tr>
<tr>
<td>23</td>
<td>Desuckering</td>
<td>10.03.94</td>
</tr>
<tr>
<td>24</td>
<td>Harvesting</td>
<td>31.03.94</td>
</tr>
<tr>
<td>25</td>
<td>Removal of Stalks</td>
<td>05.04.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>08.04.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.04.94</td>
</tr>
</tbody>
</table>
3.7 PLANT CHARACTERS STUDIED

The yield of crop is governed by the yield attributes. The following plant characters were, therefore, studied along with yield during the course of investigation.

3.7.1 Plant Height

Plant height was recorded at an interval of every 30 days, commencing from 60 days after transplanting, up to harvest for five randomly selected plants in each net plot. Plant height was measured in cm from the base of the plant to the axil of top leaf.

3.7.2 Leaf length and leaf width

The leaf length was measured from the base of the leaf to the tip of leaf of selected plants and maximum breadth represented the width of the leaf. The length and maximum width of middle three leaves (leaf nos. 6 to 8 from bottom) of the tagged plants were measured at an interval of every 30 days, commencing from 60 days after transplanting up to harvest.

3.7.3 Growth score

The growth score which is a good indicator of yield potential, was assigned on the basis of growth intensity of the crop. The grade point was given on a 0-10 scale.
3.7.4 Spangle score

Spangles are red rusty brown spots on well puckered leaves. It is a criterion for satisfactory maturity and good quality. To judge intensity of spangling, score was given depending upon the degree of spangling on the leaf. Unspangled leaf scored zero, whereas leaf having spangle to an extent of 25 per cent area scored 1, 50 per cent spangled area leaf scored 2, 75 per cent spangled area leaf scored 3 and fully spangled leaf scored 4 points.

3.7.5 Cured leaf yield

After sun drying the different components of plant, the cured leaf yield was computed by adding the weight of bhuka (lamina), rago (midrib), galia (sand leaves i.e. lower three leaves touching to the soil) and geran (portion of lamina pieces adhering to the midrib) together.

3.7.6 Dry Weight of weeds

After harvest of the tobacco crop, the weeds from 1 sq.m. area were uprooted and oven dried and their weight was recorded on hectare basis.

3.7.7 Weight of Orobanche

The weight of orobanche was recorded each time after hand pulled them from net plot area as and when they appeared in the plots. The weight of orobanche was converted into hectare basis and recorded separately for each treatment.

3.8 CHEMICAL CONSTITUENTS

The tobacco cured leaf samples were prepared for chemical analysis by grinding them in a Wiley mill by passing through a 60 mesh sieve.
3.8.1 Nicotine (%)

The nicotine content from the cured leaf was determined by Autoanalyser as per the method of Harvey et al. (1969).

3.8.2 Total nitrogen

Total N from the cured leaf samples was estimated by the Kjeldahl's method (Jackson, 1973).

3.9 STATISTICAL ANALYSIS

The data generated on cured leaf yield, quality and various characters were subjected to statistical analysis, using analysis of variance techniques. The value of calculated 'F' was worked out and compared with the value of 'table 'F' at the five per cent level of significance. Where the treatment differences were significant, value of CD was also worked out to compare the treatment effects (Snedecor and Cochran, 1967).

3.10 Field water use efficiency

The field water use efficiency was calculated by using following formula as suggested by Michael (1978).

\[
\text{Field water use efficiency} = \frac{Y}{WR}
\]

Where,

\[
Y = \text{Cured leaf yield (kg/ha)} \quad \text{WR} = \text{Water requirement (mm)}
\]

3.11 ECONOMICS

In order to evaluate the effectiveness of different treatments and to ascertain the most remunerative
treatment, the expenses incurred on all the cultural operations right from preparation of land to harvesting of the crop including cost of inputs, viz., seedlings, fertilizers, irrigations, weedicides and suckericide applied to each treatments were computed and added.

The gross realization was worked out on the basis of mean cured leaf yield per hectare of each treatment and the prevailing market prices of the produce in respective years. The net realization per hectare was calculated by deducting the total cost of cultivation from the gross realization for each treatment and recorded accordingly.

The cost benefit ratio (CBR) was calculated on the basis of formula given below:

\[
\text{CBR} = \frac{\text{Total income (Rs/ha)}}{\text{Total expenditure (Rs/ha)}}
\]

3.12 BIOASSAY TEST

To study the residual effect of weedicides on the succeeding crop, green gram (a summer season crop of Gujarat), was grown in plastic pots under laboratory
conditions after harvest of tobacco. For that, the soil samples were collected from each plot from a depth of 30 cm and the samples were put into pot. Twenty seeds of greengram were sown in each pot. The crop was irrigated regularly after sowing. The observations on germination percentage was recorded at eight days after seeding (DAS) and dry weight of seedling was noted at 15 DAS.
RESULTS
The results obtained from the present investigation on "Effect of moisture regimes, suckercide and weedicides on growth, yield and quality of rustica tobacco (Nicotiana rustica L.) cv. GC 2" are presented in this chapter. The data pertaining to growth parameters, yields and its attributes, chemical aspects and quality were subjected to statistical analysis for the test of significance of the results. The data for all the mean effects and only significant interactions are presented in succeeding paragraphs. Wherever necessary, the results have also been depicted graphically.

4.1 GROWTH ATTRIBUTES

4.1.1 Plant height (cm)

Data on periodical plant height as affected by different levels of irrigation, suckercide and weedicide are presented in Table 4.1 and graphically depicted in Fig. 4.1.

4.1.1.1 Effect of irrigation

Data given in Table 4.1 revealed that the plant height was significantly influenced by different levels of irrigation at all the growth stages during both the years of study as well as in their combined analysis.
Irrigating the crop at 1.1 IW/CPE ratio (I2) produced significantly taller plants than 0.7 (I1) and 1.5 (I3) IW/CPE ratios at all the stages of its measurement except at 60 DAP in 1994-95 as well as on pooled basis, wherein I2 and I3 being at par differed significantly from I1 treatment.

4.1.1.2 Effect of suckercide

The plant height was significantly affected during all the stages of its measurement during 1993-94 and on the pooled basis, wherein application of pendimethalin @ 0.75 % (S2) gave significantly more plant height than S1 treatment (Table 4.1). But during 1994-95 treatment differences were not significant during all the stages of its measurement.

4.1.1.3 Effect of weedicide

The differences in plant height were significant at 60 and 120 DAP during the years 1994-95 and 1993-94, respectively (Table 4.1). In case of pooled analysis significant differences were noticed only at 60 DAP. In all the above cases, W3 treatment showed its significant superiority in increasing plant height over other treatments at 60 DAP during 1994-95 and on pooled basis. But at 120 DAP during 1993-94 it was at par with rest of the treatments barring W1 treatment.
Table 4.1: Plant height at 60, 90 and 120 DAP as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 DAP</td>
</tr>
<tr>
<td><strong>Irrigation (I)</strong></td>
<td></td>
</tr>
<tr>
<td>I₁</td>
<td>41.6</td>
</tr>
<tr>
<td>I₂</td>
<td>44.5</td>
</tr>
<tr>
<td>I₃</td>
<td>43.0</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.19</td>
</tr>
<tr>
<td>C.D.at 5%</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>Suckercide (S)</strong></td>
<td></td>
</tr>
<tr>
<td>S₁</td>
<td>42.5</td>
</tr>
<tr>
<td>S₂</td>
<td>43.5</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.16</td>
</tr>
<tr>
<td>C.D.at 5%</td>
<td>0.48</td>
</tr>
<tr>
<td>C.V. %</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Weedicide (W)</strong></td>
<td></td>
</tr>
<tr>
<td>W₁</td>
<td>42.4</td>
</tr>
<tr>
<td>W₂</td>
<td>43.1</td>
</tr>
<tr>
<td>W₃</td>
<td>43.8</td>
</tr>
<tr>
<td>W₄</td>
<td>42.6</td>
</tr>
<tr>
<td>W₅</td>
<td>43.1</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.38</td>
</tr>
<tr>
<td>C.D.at 5%</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>4.3</td>
</tr>
<tr>
<td>Sign.Int.</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 4.1 Periodical plant height as influenced by varying levels of irrigation, suckericide and weedicide (Average of two years)
4.1.2 Leaf length

The mean data of the two seasons on leaf length as affected by irrigation, suckericide and weedicide are presented in Table 4.2 and graphically illustrated in Fig. 4.2.

4.1.2.1 Effect of irrigation

The results (Table 4.2) revealed that leaf length was significantly affected by different levels of irrigation at all the growth stages during both the years as well as on pooled basis. Among different levels of irrigation, I2 recorded the highest leaf length, which was significantly higher than I1 and I3 levels of irrigation except during 1993-94, wherein it was statistically found comparable to I3 irrigation level.

4.1.2.2 Effect of suckericide

The data pertaining to leaf length, presented in Table 4.2 revealed that application of suckericide (Pendimethalin 0.75 per cent) produced higher leaf length than hand desuckering. The results further revealed that leaf length was significantly influenced by suckericide application during the year 1994-95 and on the pooled basis at all the stages of crop growth. Although [leaf length] was improved by suckericidal treatments at all the stages of growth during 1993-94, the differences were found to be significant.
Table 4.2: Leaf length at 60, 90 and 120 DAP as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
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</thead>
<tbody>
<tr>
<td><strong>Irrigation (I)</strong></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>I1</td>
<td>28.1</td>
<td>29.8</td>
<td>28.9</td>
<td>31.0</td>
<td>35.1</td>
<td>33.1</td>
<td>38.1</td>
<td>39.0</td>
<td>38.5</td>
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<tr>
<td>I2</td>
<td>31.3</td>
<td>33.4</td>
<td>32.3</td>
<td>35.0</td>
<td>38.3</td>
<td>36.6</td>
<td>41.4</td>
<td>42.0</td>
<td>41.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>29.5</td>
<td>31.6</td>
<td>30.1</td>
<td>33.4</td>
<td>36.4</td>
<td>34.9</td>
<td>39.6</td>
<td>40.4</td>
<td>40.0</td>
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<tr>
<td>S. Em. ±</td>
<td>0.61</td>
<td>0.41</td>
<td>0.36</td>
<td>0.83</td>
<td>0.16</td>
<td>0.42</td>
<td>0.61</td>
<td>0.21</td>
<td>0.32</td>
<td></td>
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<tr>
<td>C. D. at 5 %</td>
<td>1.83</td>
<td>1.23</td>
<td>1.06</td>
<td>2.50</td>
<td>0.48</td>
<td>1.22</td>
<td>1.83</td>
<td>0.63</td>
<td>0.92</td>
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<td><strong>Suckercide (S)</strong></td>
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<tr>
<td>S1</td>
<td>29.0</td>
<td>31.0</td>
<td>30.0</td>
<td>32.2</td>
<td>36.2</td>
<td>34.2</td>
<td>39.1</td>
<td>39.7</td>
<td>39.4</td>
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<tr>
<td>S2</td>
<td>30.3</td>
<td>32.2</td>
<td>31.2</td>
<td>34.0</td>
<td>37.0</td>
<td>35.5</td>
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<td>41.2</td>
<td>40.7</td>
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<tr>
<td>S. Em. ±</td>
<td>0.50</td>
<td>0.33</td>
<td>0.30</td>
<td>0.68</td>
<td>0.13</td>
<td>0.35</td>
<td>0.49</td>
<td>0.17</td>
<td>0.26</td>
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<tr>
<td>C. D. at 5 %</td>
<td>NS</td>
<td>0.99</td>
<td>0.87</td>
<td>NS</td>
<td>0.39</td>
<td>1.00</td>
<td>NS</td>
<td>0.51</td>
<td>0.75</td>
<td></td>
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<tr>
<td>C. V. %</td>
<td>13.1</td>
<td>8.1</td>
<td>10.8</td>
<td>15.9</td>
<td>2.7</td>
<td>10.9</td>
<td>9.7</td>
<td>3.3</td>
<td>7.2</td>
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<tr>
<td><strong>Weedicide (W)</strong></td>
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<tr>
<td>W1</td>
<td>29.0</td>
<td>31.1</td>
<td>30.0</td>
<td>31.6</td>
<td>35.9</td>
<td>33.8</td>
<td>39.1</td>
<td>39.4</td>
<td>39.3</td>
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</tr>
<tr>
<td>W2</td>
<td>29.9</td>
<td>30.8</td>
<td>30.4</td>
<td>33.8</td>
<td>36.9</td>
<td>35.3</td>
<td>39.9</td>
<td>40.4</td>
<td>40.1</td>
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</tr>
<tr>
<td>W3</td>
<td>30.7</td>
<td>32.6</td>
<td>31.6</td>
<td>34.1</td>
<td>37.4</td>
<td>35.8</td>
<td>40.5</td>
<td>41.6</td>
<td>41.0</td>
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<tr>
<td>W4</td>
<td>29.1</td>
<td>31.5</td>
<td>30.3</td>
<td>32.8</td>
<td>36.2</td>
<td>34.5</td>
<td>39.1</td>
<td>40.3</td>
<td>39.7</td>
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<tr>
<td>W5</td>
<td>29.5</td>
<td>32.0</td>
<td>30.7</td>
<td>33.3</td>
<td>36.7</td>
<td>35.0</td>
<td>39.8</td>
<td>40.6</td>
<td>40.2</td>
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<td></td>
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</tr>
<tr>
<td>S. Em. ±</td>
<td>0.52</td>
<td>0.53</td>
<td>0.37</td>
<td>0.90</td>
<td>0.27</td>
<td>0.47</td>
<td>0.58</td>
<td>0.21</td>
<td>0.30</td>
<td></td>
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<tr>
<td>C. D. at 5 %</td>
<td>NS</td>
<td>NS</td>
<td>1.03</td>
<td>NS</td>
<td>0.75</td>
<td>1.30</td>
<td>NS</td>
<td>0.59</td>
<td>0.85</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>C. V. %</td>
<td>8.7</td>
<td>8.2</td>
<td>8.4</td>
<td>13.3</td>
<td>3.6</td>
<td>9.3</td>
<td>7.2</td>
<td>2.5</td>
<td>5.3</td>
<td></td>
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<tr>
<td>Sign. Int.</td>
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</tbody>
</table>
Fig. 4.2 Periodical leaf length as influenced by varying levels of irrigation, suckericide and weedicide (Average of two years)
4.1.2.3 Effect of weedicide

Leaf length at 60 DAP during 1993-94 and 1994-95 was not significantly affected by weedicide application. But on the pooled basis, data showed significant variation at 60 DAP, wherein, W3 being at par with W5 recorded significantly higher leaf length than the rest of the treatments. At 90 and 120 DAP during 1993-94, differences in leaf length were not significant. But during 1994-95 and in the combined analysis at both these stages, leaf length was significantly altered by the treatments and treatment W3 recorded maximum plant height at 90 DAP, which differed significantly from the rest of the treatments barring W2 and W5 treatments, the latter two treatments were found to be at par with W4. At 120 DAP during 1994-95, W3 recorded significantly the highest leaf length, but on the pooled basis W3 being at par with W5 differed significantly from the rest.

4.1.3 Leaf width

Data on leaf width measured at 60, 90 and 120 DAP for two seasons for each treatment are presented in Table 4.3 and graphically depicted in Fig. 4.3.

4.1.3.1 Effect of Irrigation

Statistical analysis of data (Table 4.3) revealed that different levels of irrigation significantly influenced the leaf width at all the stages of observations during
Table 4.3: Leaf width at 60, 90 and 120 DAP as influenced by irrigation, suckericide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaf width (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 DAP</td>
</tr>
</tbody>
</table>

**Irrigation (I)**

| I1 | 17.0 | 21.4 | 19.2 | 20.0 | 24.4 | 22.2 | 25.8 | 27.0 | 26.4 |
| I2 | 20.0 | 24.5 | 22.2 | 22.7 | 27.6 | 25.2 | 28.7 | 29.4 | 29.1 |
| I3 | 18.5 | 23.3 | 20.9 | 21.4 | 26.1 | 23.7 | 26.9 | 28.2 | 27.6 |
| S. Em. † | 0.56 | 0.07 | 0.28 | 0.62 | 0.06 | 0.31 | 0.55 | 0.11 | 0.28 |
| C.D. at 5% | 1.68 | 0.21 | 0.81 | 1.86 | 0.18 | 0.90 | 1.65 | 0.33 | 0.80 |

**Suckericide (S)**

| S1 | 18.0 | 22.5 | 20.2 | 20.8 | 25.4 | 23.1 | 26.8 | 27.9 | 27.3 |
| S2 | 19.0 | 23.6 | 21.3 | 22.0 | 26.7 | 24.3 | 27.5 | 28.5 | 28.0 |
| S. Em. † | 0.46 | 0.06 | 0.23 | 0.51 | 0.05 | 0.26 | 0.45 | 0.09 | 0.23 |
| C.D. at 5% | NS | 0.18 | 0.67 | NS | 0.15 | 0.75 | NS | 0.27 | 0.67 |
| C.V. % | 19.2 | 1.9 | 12.2 | 18.5 | 1.4 | 11.8 | 12.7 | 2.4 | 9.0 |

**Weedicide (W)**

| W1 | 18.1 | 22.4 | 20.3 | 20.9 | 25.4 | 23.2 | 26.7 | 27.6 | 27.2 |
| W2 | 18.6 | 23.1 | 20.9 | 21.6 | 26.1 | 23.9 | 27.2 | 28.4 | 27.8 |
| W3 | 19.2 | 24.0 | 21.6 | 22.1 | 26.8 | 24.5 | 27.7 | 29.1 | 28.4 |
| W4 | 18.3 | 22.7 | 20.5 | 21.0 | 25.7 | 23.4 | 26.8 | 27.7 | 27.3 |
| W5 | 18.3 | 22.9 | 20.6 | 21.3 | 26.1 | 23.7 | 27.3 | 28.1 | 27.7 |
| S. Em. † | 0.51 | 0.10 | 0.26 | 0.54 | 0.09 | 0.27 | 0.51 | 0.18 | 0.27 |
| C.D. at 5% | NS | 0.29 | 0.71 | NS | 0.25 | 0.75 | NS | 0.50 | 0.75 |
| C.V. % | 13.4 | 2.2 | 8.6 | 12.3 | 1.7 | 7.9 | 9.3 | 3.1 | 6.8 |

Sign.Int. - I x S - - I x S - - -
Fig. 4.3 Periodical leaf width as influenced by varying levels of irrigation, suckercide and weedicide (average of two years)
1993-94, 1994-95 and in pooled analysis. It is observed from the data that irrigating the crop at 1.1 IW/CPE ratio \((I_2)\) gave significantly higher leaf width at all the stages than 0.7 \((I_1)\) and 1.5 \((I_3)\) IW/CPE ratio, except at 60 and 90 DAP stages during 1993-94, wherein \(I_2\) and \(I_3\) levels did not differ significantly from each other.

4.1.3.2 Effect of suckericide

The leaf width was significantly changed due to suckericide application during 1994-95 as well as on pooled basis, while the first year (1993-94) results failed to show significant variation (Table 4.3). During the year 1994-95 as well as in pooled analysis, treatment \(S_2\) (Pendimethalin 0.75 per cent) recorded the highest values of leaf width at all the stages of crop growth.

4.1.3.1 Effect of weedicide

The weedicide treatments, significantly affected the leaf width during 1994-95 and on the pooled basis, while during 1993-94 crop season, differences in leaf width were not significant at all the stages of its measurement. During 1994-95, \(W_3\) treatment had proved its superiority by recording significantly higher values \((24.0 - 29.1)\) but on the pooled basis though \(W_3\) treatment recorded higher leaf width \((21.6-28.4)\), the difference in leaf width between \(W_3\) and \(W_2\) treatments was not remarkable.
4.1.3.4 Interaction effect

The interaction effect \( I \times S \) during 1994-95 at 60 and 90 DAP for leaf width was found significant (Table 4.4).

The data presented in Table 4.4 revealed that \( I_2S_2 \) treatments combination recorded significantly the highest leaf width at 60 and 90 DAP during 1994-95.

Table 4.4: Leaf width (cm) at 60 and 90 DAP as influenced by irrigation \( \times \) suckericide \( (I \times S) \) interaction during 1994-95

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Suckericide</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>60 DAP</td>
<td>90 DAP</td>
</tr>
<tr>
<td>I(_1)</td>
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<td>20.5</td>
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</tr>
<tr>
<td>I(_2)</td>
<td></td>
<td>24.0</td>
<td>27.2</td>
</tr>
<tr>
<td>I(_3)</td>
<td></td>
<td>22.9</td>
<td>25.7</td>
</tr>
<tr>
<td>S.Em.(\pm)</td>
<td></td>
<td>0.10</td>
<td>0.08</td>
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<tr>
<td>C.D. at 5 %</td>
<td></td>
<td>0.30</td>
<td>0.24</td>
</tr>
</tbody>
</table>

4.1.4 Cured leaf yield

Data on cured leaf yield as influenced by irrigation, suckericide and weedicide treatments are given in Table 4.5 and graphically illustrated in Fig. 4.4.
Table 4.5 : Cured leaf yield as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cured leaf yield (kg/ha)</th>
<th>1993-94</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;1&lt;/sub&gt;</td>
<td></td>
<td>2405</td>
<td>3409</td>
<td>2907</td>
</tr>
<tr>
<td>I&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td>2927</td>
<td>4291</td>
<td>3609</td>
</tr>
<tr>
<td>I&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td>2596</td>
<td>3725</td>
<td>3161</td>
</tr>
<tr>
<td>S.Em.±</td>
<td></td>
<td>79.1</td>
<td>106.6</td>
<td>66.4</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td></td>
<td>238.4</td>
<td>321.3</td>
<td>191.8</td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S&lt;sub&gt;1&lt;/sub&gt;</td>
<td></td>
<td>2517</td>
<td>3653</td>
<td>3085</td>
</tr>
<tr>
<td>S&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td>2768</td>
<td>3965</td>
<td>3366</td>
</tr>
<tr>
<td>S.Em.±</td>
<td></td>
<td>64.6</td>
<td>87.1</td>
<td>54.22</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td></td>
<td>194.6</td>
<td>262.4</td>
<td>156.15</td>
</tr>
<tr>
<td>C.V. %</td>
<td></td>
<td>18.9</td>
<td>17.7</td>
<td>18.4</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W&lt;sub&gt;1&lt;/sub&gt;</td>
<td></td>
<td>2328</td>
<td>3564</td>
<td>2946</td>
</tr>
<tr>
<td>W&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td>2599</td>
<td>3775</td>
<td>3187</td>
</tr>
<tr>
<td>W&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td>3042</td>
<td>4233</td>
<td>3638</td>
</tr>
<tr>
<td>W&lt;sub&gt;4&lt;/sub&gt;</td>
<td></td>
<td>2541</td>
<td>3602</td>
<td>3072</td>
</tr>
<tr>
<td>W&lt;sub&gt;5&lt;/sub&gt;</td>
<td></td>
<td>2703</td>
<td>3870</td>
<td>3287</td>
</tr>
<tr>
<td>S.Em.±</td>
<td></td>
<td>84.7</td>
<td>79.3</td>
<td>58.0</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td></td>
<td>238.5</td>
<td>223.3</td>
<td>160.9</td>
</tr>
<tr>
<td>C.V. %</td>
<td></td>
<td>15.7</td>
<td>10.2</td>
<td>12.5</td>
</tr>
<tr>
<td>Sign.Int.</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 4.4 Cured leaf yield (kg/ha) as influenced by varying levels of irrigation, suckercide and weedicide
4.1.4.1 Effect of irrigation

It is evident from the data presented in Table 4.5 that varying IW/CPE ratios tested in the experiment had significant effect on the cured leaf yield during both the years as well as on pooled basis. Irrigating the crop at 1.1 IW/CPE ratio (I_2) clearly showed significant superiority in increasing cured leaf yield over I_1 (0.7 IW/CPE ratio) and I_3 (1.5 IW/CPE ratio) during both the years as well as in the combined analysis. This ratio recorded maximum cured leaf yield of 2927, 4291 and 3609 kg/ha during 1993-94, 1994-95 and on pooled basis, respectively.

4.1.4.2 Effect of suckericide

Chemical desuckering (S_2) clearly showed significant superiority in improving cured leaf yield over hand desuckering (S_1) during both the years as well as in the combined analysis (Table 4.5). Treatment S_2 recorded cured leaf yield of 2768, 3965 and 3366 kg/ha during 1993-94, 1994-95 and on pooled basis, respectively.

4.1.4.3 Effect of weedicide

A perusal of data given in Table 4.5 revealed significant differences in cured leaf yield due to weedicides, wherein application of fluchloralin @ 1.5 lit/ha (W_3) significantly improved the cured leaf yield (3042 - 4233 kg/ha) over other treatments during both the
years and also in the pooled results. Results further revealed that local practices of weed management (W1) lagged behind all other weedicides and it had recorded the lower values, however the difference in cured leaf yield between W1 and W4 was not significant during both the years of study and on pooled basis. The differences in yield between latter treatment with W5 and former treatment with W2 were also not significant during 1993-94 and 1994-95, respectively.

4.1.5 Fresh weight of suckers

The mean data on fresh weight of suckers as influenced by irrigation, suckercide and weedicide treatments are presented in Table 4.6 and graphically illustrated in Fig. 4.5.

4.1.5.1 Effect of irrigation

It is evident from the data presented in Table 4.6 that application of irrigation significantly affected the fresh weight of suckers during both the years as well as in pooled analysis. The results indicated gradual increase in sucker weight at each increasing level of applied irrigation as the difference between two consecutive levels was almost identical. Irrigation scheduled at IW/CPE ratio 1.5 (I3) recorded significantly the highest fresh weight of suckers and the values were 38.74, 50.11 and 44.43 q/ha, respectively for 1993-94, 1994-95 and on pooled results.
Table 4.6: Fresh weight of suckers as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh weight of suckers (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1993-94</td>
</tr>
<tr>
<td>Irrigation (I)</td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>27.78</td>
</tr>
<tr>
<td>I2</td>
<td>33.03</td>
</tr>
<tr>
<td>I3</td>
<td>38.74</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.92</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>2.78</td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>34.65</td>
</tr>
<tr>
<td>S2</td>
<td>31.72</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.75</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>2.27</td>
</tr>
<tr>
<td>C.V. %</td>
<td>17.6</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>31.15</td>
</tr>
<tr>
<td>W2</td>
<td>33.52</td>
</tr>
<tr>
<td>W3</td>
<td>34.67</td>
</tr>
<tr>
<td>W4</td>
<td>32.82</td>
</tr>
<tr>
<td>W5</td>
<td>33.76</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>1.62</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>23.9</td>
</tr>
<tr>
<td>Sign. Int.</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 4.5 Fresh weight of suckers (q/ha) as influenced by varying levels of irrigation, suckercide and weedicide
4.1.5.2 Effect of suckericide

The effect of application of suckericide on fresh weight of suckers was found significant during both the years as well as in the pooled analysis (Table 4.6). The results further revealed that chemical desuckering (S2) produced significantly the lowest fresh weight of suckers.

4.1.5.3 Effect of weedicide

It is evident from the data (Table 4.6) that different treatments of weedicide failed to exert significant influence on fresh weight of suckers during both the years as well as in the combined analysis. The critical examination of data indicated increase in weight of suckers due to application of weedicides (W2, W3, W4 and W5) over conventional method of weeding (W1).

4.1.6 Spangle score

The results on spangle score as influenced by irrigation, suckericide and weedicide treatments are presented in Table 4.7 and graphically illustrated in Fig. 4.6.

4.1.6.1 Effect of irrigation

The differences in spangle score due to different IW/CPE ratios were found to be significant during 1993-94, 1994-95 and on the pooled basis. Among different ratios, I2
Table 4.7: Spangle score as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Spangle score (0-4)</th>
<th>1993-94</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>2.40</td>
<td>2.20</td>
<td>2.29</td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>3.16</td>
<td>2.84</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>2.74</td>
<td>2.37</td>
<td>2.55</td>
<td></td>
</tr>
<tr>
<td>S.Em. ±</td>
<td>0.05</td>
<td>0.07</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.15</td>
<td>0.21</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>2.67</td>
<td>2.37</td>
<td>2.51</td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>2.86</td>
<td>2.57</td>
<td>2.71</td>
<td></td>
</tr>
<tr>
<td>S.Em. ±</td>
<td>0.04</td>
<td>0.06</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.12</td>
<td>0.18</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>C.V. %</td>
<td>11.9</td>
<td>17.5</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>2.70</td>
<td>2.39</td>
<td>2.54</td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td>2.83</td>
<td>2.61</td>
<td>2.67</td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td>2.83</td>
<td>2.54</td>
<td>2.68</td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td>2.77</td>
<td>2.47</td>
<td>2.61</td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td>2.70</td>
<td>2.44</td>
<td>2.57</td>
<td></td>
</tr>
<tr>
<td>S.Em. ±</td>
<td>0.05</td>
<td>0.06</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>C.V. %</td>
<td>9.1</td>
<td>12.5</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>Sign.Int.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 4.6 Spangle score (0-4) as influenced by varying levels of irrigation, suckercide and weedicide.
(1.1 IW/CPE ratio) recorded highest spangle score, which differed significantly from both I₁ (0.7) and I₃ (1.5) ratios. The minimum spangle score was recorded under I₁ treatment, while I₃ showed intermediate value for the spangle score.

4.1.6.2 Effect of suckericide

Among two suckericidal treatments, S₂ (pendimethalin 0.75 per cent) recorded significantly higher spangle score during both the years and also in pooled analysis than S₁ (hand desuckering) treatment.

4.1.6.3 Effect of weedicide

A perusal of data given in Table 4.7 revealed that different treatments of weedicide did not show significant influence on the spangle score during both the years of experimentation as well as on the pooled basis. However, treatment W₃ followed by W₄ showed marginal increase in spangle score over others.

4.1.7 Growth score

Data on growth score as influenced by irrigation, suckericide and weedicide treatments are presented in Table 4.8 and graphically depicted in Fig. 4.7.
Table 4.8: Growth score as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1993-94</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I₁</td>
<td>6.33</td>
<td>6.34</td>
<td>6.33</td>
</tr>
<tr>
<td>I₂</td>
<td>7.15</td>
<td>7.11</td>
<td>7.13</td>
</tr>
<tr>
<td>I₃</td>
<td>6.55</td>
<td>6.58</td>
<td>6.56</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>6.06</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.19</td>
<td>0.17</td>
<td>0.12</td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₁</td>
<td>6.58</td>
<td>6.62</td>
<td>6.59</td>
</tr>
<tr>
<td>S₂</td>
<td>6.77</td>
<td>6.74</td>
<td>6.75</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.05</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.15</td>
<td>NS</td>
<td>0.10</td>
</tr>
<tr>
<td>C.V. %</td>
<td>5.8</td>
<td>5.3</td>
<td>5.6</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W₁</td>
<td>6.69</td>
<td>6.63</td>
<td>6.65</td>
</tr>
<tr>
<td>W₂</td>
<td>6.68</td>
<td>6.69</td>
<td>6.68</td>
</tr>
<tr>
<td>W₃</td>
<td>6.85</td>
<td>6.78</td>
<td>6.81</td>
</tr>
<tr>
<td>W₄</td>
<td>6.55</td>
<td>6.66</td>
<td>6.60</td>
</tr>
<tr>
<td>W₅</td>
<td>6.61</td>
<td>6.64</td>
<td>6.62</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.07</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>5.0</td>
<td>4.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Sign. Int.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 4.7 Growth score (0-10) as influenced by varying levels of irrigation, suckericide and weedicide
4.1.7.1 Effect of irrigation

The differences in growth score due to different levels of irrigations were found to be significant during both the years as well as on the pooled basis. Statistical analysis of data revealed that 1.1 IW/CPE ratio (I2) gave significantly higher value of growth score than 1.5 (I3) and 0.7 (I1) IW/CPE ratios. Between I1 and I3 treatments, latter recorded significantly higher growth score in the individual years as well as on the pooled basis.

4.1.7.2 Effect of suckericide

Among two suckericidal treatments application of pendimethalin (S2) recorded significantly higher growth score, than hand desuckering (S1) treatment during the year 1993-94 and in pooled analysis, but during the year 1994-95 the difference was found to be non-significant.

4.1.7.3 Effect of weedicide

Data given in Table 4.8 revealed that different levels of weedicide did not show significant influence on the growth score during both the years as well as on the pooled basis. Although results were not significant, maximum values of growth score were recorded under W3 (Fluchloralin @ 1.5 lit/ha) treatment during both the years of experimentation and on the pooled basis.
4.1.8 Dry weight of weeds

The mean data on dry weight of weeds (kg/ha) as influenced by irrigations, suckercide and weedicides are presented in Table 4.9 and graphically depicted in Fig. 4.8.

4.1.8.1 Effect of irrigation

A perusal of data given in Table 4.9 indicated that there were significant differences in dry weight of weeds among different irrigation levels during the year 1994-95 and on the pooled basis. But during the first year of the experimentation, the differences were not significant. It was further noticed that dry weight of weeds was, in general, increased with increase in the number of irrigations and irrigating the crop at 1.5 IW/CPE ratio (I3) recorded significantly the highest dry weight of weeds during 1994-95 and on the pooled basis. The lowest dry weight was recorded under lowest IW/CPE ratio of 0.7 (I1), however, the differences in dry weight of weeds were not variable among irrigation levels of I1, I2 and I3 during 1993-94 and between I1 and I2 on pooled basis.

4.1.8.2 Effect of suckercide

The differences in dry weight of weeds as influenced by suckercide treatments were not significant during 1993-94 and in pooled analysis (Table 4.9). But
Table 4.9: Dry weight of weeds as influenced by irrigation, suckericide and weedicide treatments at harvest

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dry weight of weeds (Kg/ha)</th>
<th>1993-94</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Irrigation (I)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>575.6</td>
<td>599.1</td>
<td>587.4</td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>577.4</td>
<td>671.4</td>
<td>624.4</td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>661.9</td>
<td>734.6</td>
<td>698.2</td>
<td></td>
</tr>
<tr>
<td><strong>S.Em.±</strong></td>
<td></td>
<td>26.07</td>
<td>1.62</td>
<td>13.06</td>
</tr>
<tr>
<td><strong>C.D. at 5 %</strong></td>
<td></td>
<td>NS</td>
<td>4.88</td>
<td>37.71</td>
</tr>
<tr>
<td><strong>Suckericide (S)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>588.8</td>
<td>670.6</td>
<td>629.7</td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>621.0</td>
<td>666.1</td>
<td>643.6</td>
<td></td>
</tr>
<tr>
<td><strong>S.Em.±</strong></td>
<td></td>
<td>21.29</td>
<td>1.32</td>
<td>15.08</td>
</tr>
<tr>
<td><strong>C.D. at 5 %</strong></td>
<td></td>
<td>NS</td>
<td>3.99</td>
<td>NS</td>
</tr>
<tr>
<td><strong>C.V. %</strong></td>
<td></td>
<td>27.3</td>
<td>1.5</td>
<td>18.4</td>
</tr>
<tr>
<td><strong>Weedicide (W)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>1053.8</td>
<td>1169.7</td>
<td>1111.7</td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td>766.7</td>
<td>854.0</td>
<td>810.4</td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td>72.3</td>
<td>97.5</td>
<td>84.9</td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td>823.0</td>
<td>931.8</td>
<td>877.4</td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td>308.9</td>
<td>288.8</td>
<td>298.8</td>
<td></td>
</tr>
<tr>
<td><strong>S.Em.±</strong></td>
<td></td>
<td>33.69</td>
<td>2.52</td>
<td>29.38</td>
</tr>
<tr>
<td><strong>C.D. at 5 %</strong></td>
<td></td>
<td>95.29</td>
<td>7.13</td>
<td>115.35</td>
</tr>
<tr>
<td><strong>C.V. %</strong></td>
<td></td>
<td>27.3</td>
<td>1.8</td>
<td>18.4</td>
</tr>
<tr>
<td><strong>Sign.Int.</strong></td>
<td></td>
<td>IxS, IxW, YxW, SxW, IxSxW</td>
<td>IxW</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 4.8 Dry weight of weeds (kg/ha) as influenced by varying levels of irrigation, suckericide and weedicide.
application of pendimethalin (S2) significantly decreased the dry weight of weeds over hand desuckering (S1).

4.1.8.3 Effect of weedicide

It was observed from the data presented in Table 4.9 that the differences in dry weight of weeds due to different weedicide treatments were significant during both the years as well as in pooled analysis. Significantly lowest dry weight of weeds was recorded with W3 (fluchloralin 1.5 l/ha) followed by W5 (pendimethalin 1.5 l/ha) during both the years as well as in pooled basis. Among different treatments, W1 (local practice) treatment lagged behind all other treatments in reducing the dry weight of weeds and it had significantly recorded the highest values of dry weight of weeds during both the years as well as on pooled basis. The lower level of both the weedicides (W2 and W4) were on par during 1993-94 and in pooled analysis. During 1994-95 also consistent trend was noticed, but all the treatments differed significantly from each other.

4.1.8.4 Interaction effect

Among all the possible interactions, I x S, I x W, S x W and I x S x W interactions were found significant in the second year (1994-95), while only Y x W and I x W interactions were found significant on pooled basis. The
data regarding I x S, I x W, S x W, I x S x W and Y x W are presented in Table 4.10, 4.11, 4.12, 4.13 and 4.14 and, respectively.

Table 4.10: Dry weight of weeds as influenced by Irrigation x Suckercide (I x S) interaction during 1994-95

<table>
<thead>
<tr>
<th>Irrigation (I)</th>
<th>Suckercide (S)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1</td>
<td>S2</td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>600.5</td>
<td>597.7</td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>678.6</td>
<td>664.1</td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>732.6</td>
<td>736.5</td>
<td></td>
</tr>
<tr>
<td>S.Em.‡</td>
<td>2.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.D. at 5%</td>
<td>6.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data pertaining to I x S interaction (Table 4.10) revealed that the treatment combination I₁S₂ produced significantly lower dry weight of weeds than the rest of the treatments except I₁S₁ treatment, while I₃S₂ being on par with I₃S₁ gave significantly higher dry weight of weeds than the remaining treatment combinations.

Data (Table 4.11) on I x W interaction showed that the treatment combination I₃W₁ recorded significantly the highest dry weight of weeds, while I₁W₃ recorded
Table 4.11: Dry weight of weeds as influenced by irrigation x weedicide (I x W) interaction during 1994-95 and in pooled analysis

<table>
<thead>
<tr>
<th>Irrigation (I)</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( W_1 )</td>
<td>( W_2 )</td>
</tr>
<tr>
<td>( I_1 )</td>
<td>1058.3</td>
<td>739.9</td>
</tr>
<tr>
<td>( I_2 )</td>
<td>1147.5</td>
<td>891.0</td>
</tr>
<tr>
<td>( I_3 )</td>
<td>1303.3</td>
<td>931.4</td>
</tr>
<tr>
<td>S. Err. ( \dagger )</td>
<td>2.52</td>
<td></td>
</tr>
<tr>
<td>C. D. at 5%</td>
<td>7.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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significantly the lowest dry weight of weeds during 1994-95 and on the pooled basis also, but latter was at par with I2W3 and I3W3 treatment combinations on pooled basis.

Table 4.12 : Dry weight of weeds as influenced by Suckericide x Weedicide (S x W) interaction during 1994-95

<table>
<thead>
<tr>
<th>Suckericide (S)</th>
<th>Weedicide (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
</tr>
<tr>
<td>S1</td>
<td>1172.5</td>
</tr>
<tr>
<td>S2</td>
<td>1166.8</td>
</tr>
<tr>
<td>S.Em. ±</td>
<td>4.37</td>
</tr>
<tr>
<td>C.D. at 5%</td>
<td>12.35</td>
</tr>
</tbody>
</table>

Data presented in Table 4.12 revealed that S2W3 followed by S1W3 treatment combinations recorded significantly lower dry weight of weeds than other treatment combinations. The highest dry weight of weeds was recorded under S1W1, which was at par with S2W1 but differed significantly from the rest of the treatment combinations.

Table 4.13 : Dry weight of weeds as influenced by Irrigation x Suckericide x Weedicide (I x S x W) interaction during 1994-95

<table>
<thead>
<tr>
<th>Irrigation x Suckericide (I x S)</th>
<th>Weedicide (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
</tr>
<tr>
<td>I1S1</td>
<td>1034.3</td>
</tr>
<tr>
<td>I1S2</td>
<td>1082.3</td>
</tr>
<tr>
<td>I2S1</td>
<td>1162.3</td>
</tr>
<tr>
<td>I2S2</td>
<td>1132.8</td>
</tr>
<tr>
<td>I3S1</td>
<td>1321.0</td>
</tr>
<tr>
<td>I3S2</td>
<td>1285.5</td>
</tr>
<tr>
<td>S.Em. ±</td>
<td>3.57</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>10.09</td>
</tr>
</tbody>
</table>
The higher order interaction for dry weight of weeds (Table 4.13) revealed that $I_1S_1W_3$ treatment combination registered the lowest dry weight of weeds during 1994-95, which was found at par with $I_1S_2W_3$ treatment combination, but both differed significantly from the rest of the combinations of irrigation, suckercide and weedicide treatments. The significantly highest dry weight of weeds was recorded under $I_3S_1W_1$ treatment combination.

Table 4.14: Dry weight of weeds as influenced by year x weedicide ($Y \times W$) interaction in pooled analysis

<table>
<thead>
<tr>
<th>Year (Y)</th>
<th>Weedicide (W)</th>
<th>$W_1$</th>
<th>$W_2$</th>
<th>$W_3$</th>
<th>$W_4$</th>
<th>$W_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_1$</td>
<td></td>
<td>1053.8</td>
<td>766.7</td>
<td>72.3</td>
<td>823.0</td>
<td>308.9</td>
</tr>
<tr>
<td>$Y_2$</td>
<td></td>
<td>1169.7</td>
<td>854.1</td>
<td>97.5</td>
<td>931.8</td>
<td>288.8</td>
</tr>
<tr>
<td>S.Em. ±</td>
<td></td>
<td>23.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td></td>
<td>66.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The data presented in Table 4.14 revealed that on the pooled basis, treatment combination $Y_1W_3$ showed lowest dry weight of weeds, which being on par with $Y_2W_3$ combination, differed significantly from the other combinations. The dry weight of weeds was significantly the highest during second year of experimentation under $W_1$ treatment ($Y_2W_1$).
4.1.9 Weight of orobanche

Data regarding orobanche weight as affected by different levels of irrigation, suckericide and weedicide are presented in Table 4.15 and graphically depicted in Fig. 4.9.

4.1.9.1 Effect of irrigation

The differences in orobanche weight as influenced by irrigation levels were not significant during 1993-94. However, the weight of orobanche tended to increase due to increasing levels of irrigation. On the other hand, during 1994-95 and on pooled basis results showed significant effect, wherein the increased levels of irrigation significantly increased the weight of orobanche. The highest values of orobanche weight were recorded at I3, while significantly the lowest values were under I1 level.

4.1.9.2 Effect of suckericide

A critical examination of data presented in Table 4.15 showed that the differences in orobanche weight as influenced by suckericides were not significant during 1993-94 and on pooled basis. However, the application of (pendimethalin 0.75 per cent) decreased the weight of orobanche. On the other hand, the 1994-95 results showed significant effect, wherein the application of suckericide (S2) significantly decreased the weight of orobanche over S1.
Table 4.15: Weight of orobanche (Angular transformed) as influenced by irrigation, suckericide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1993-94</th>
<th>1994-95</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log (x)</td>
<td>Retr.</td>
<td>Log (x)</td>
</tr>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I₁</td>
<td>2.812</td>
<td>(648.6)</td>
<td>2.580</td>
</tr>
<tr>
<td>I₂</td>
<td>2.932</td>
<td>(855.1)</td>
<td>2.876</td>
</tr>
<tr>
<td>I₃</td>
<td>3.076</td>
<td>(1191.2)</td>
<td>3.056</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.091</td>
<td>-</td>
<td>0.030</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>-</td>
<td>0.090</td>
</tr>
<tr>
<td>Suckericide (S)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₁</td>
<td>3.007</td>
<td>(1016.2)</td>
<td>2.876</td>
</tr>
<tr>
<td>S₂</td>
<td>2.877</td>
<td>(753.3)</td>
<td>2.796</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.075</td>
<td>-</td>
<td>0.024</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>-</td>
<td>0.072</td>
</tr>
<tr>
<td>C.V. %</td>
<td>19.6</td>
<td>-</td>
<td>6.6</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W₁</td>
<td>2.958</td>
<td>(907.8)</td>
<td>2.856</td>
</tr>
<tr>
<td>W₂</td>
<td>2.863</td>
<td>(729.5)</td>
<td>2.821</td>
</tr>
<tr>
<td>W₃</td>
<td>2.893</td>
<td>(781.6)</td>
<td>2.821</td>
</tr>
<tr>
<td>W₄</td>
<td>3.018</td>
<td>(1042.3)</td>
<td>2.850</td>
</tr>
<tr>
<td>W₅</td>
<td>2.968</td>
<td>(929.0)</td>
<td>2.838</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.088</td>
<td>-</td>
<td>0.037</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>14.7</td>
<td>-</td>
<td>6.3</td>
</tr>
<tr>
<td>Sign. Int.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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Fig. 4.9 Weight of orobanche (kg/ha) as influenced by varying levels of irrigation, suckericide and weedicide.
4.1.9.3 Effect of weedicide

Data furnished in Table 4.15 revealed that different levels of weedicides did not exert significant influence on orobanche weight during individual years as well as in pooled analysis.

4.2 CHEMICAL COMPOSITION

The effect of irrigations, suckericide and weedicides on total-N and nicotine contents are given in Table 4.16 and they are graphically depicted in Fig. 4.10 and 4.11, respectively.

4.2.1 Effect of irrigation

It was observed from the data presented in Table 4.16 that total-N and nicotine contents were significantly modified during both the years due to different levels of irrigation. However, on the pooled basis nicotine content was not significantly affected by irrigation levels. Among different IW/CPE ratios, I1 (0.7) recorded the highest values for both the attributes during both the years and also on the pooled basis. Data further revealed that total nitrogen and nicotine contents were decreased with the increasing levels of IW/CPE ratio during both the years and on the pooled basis and the lowest values of both these attributes were recorded under higher IW/CPE ratio 1.5. But in case of total nitrogen during
Table 4.16: Total nitrogen and nicotine contents as influenced by irrigation, suckercide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total nitrogen (%)</th>
<th>Nicotine content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>2.47</td>
<td>3.24</td>
</tr>
<tr>
<td>I2</td>
<td>2.26</td>
<td>3.08</td>
</tr>
<tr>
<td>I3</td>
<td>1.91</td>
<td>2.65</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.22</td>
<td>0.16</td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>2.30</td>
<td>3.09</td>
</tr>
<tr>
<td>S2</td>
<td>2.12</td>
<td>2.89</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>0.13</td>
</tr>
<tr>
<td>C.V. %</td>
<td>12.2</td>
<td>6.4</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>2.32</td>
<td>3.08</td>
</tr>
<tr>
<td>W2</td>
<td>2.26</td>
<td>2.97</td>
</tr>
<tr>
<td>W3</td>
<td>2.18</td>
<td>2.86</td>
</tr>
<tr>
<td>W4</td>
<td>2.22</td>
<td>3.03</td>
</tr>
<tr>
<td>W5</td>
<td>2.08</td>
<td>3.01</td>
</tr>
<tr>
<td>S. Em. ±</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.14</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>7.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Sign. Int.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 4.10 Total nitrogen (%) as influenced by varying levels of irrigation, suckercide, and weedicide.
Fig. 4.11 Nicotine content (%) as influenced by varying levels of irrigation, suckericide and weedicide
1993-94 and 1994-95, the $I_1$ and $I_2$ irrigation levels were found at par and showed superiority over $I_3$.

4.2.2 Effect of suckericide

It was evident from the data presented in Table 4.16 that the effect of suckericide treatment was found to be significant with respect to total-N and nicotine contents during both the years of experimentation as well as in the pooled analysis except for total-N during 1993-94. Between two treatments, $S_1$ showed highest values for total-N during both the years as well as on pooled basis, while the reverse trend was noted for nicotine content, wherein $S_2$ treatment recorded the highest value.

4.2.3 Effect of weedicide

It is obvious from the data (Table 4.16) that the differences in total nitrogen were found significant due to different weedicide treatments during the year 1993-94 and on pooled basis. Among different treatments, $W_1$ recorded highest nitrogen content, which differed significantly from the rest of the treatments on the pooled basis, while during 1993-94 it was on par with $W_2$ and $W_4$ treatments. In case of nicotine content significant differences were noted on the pooled basis only, wherein $W_1$ registered the highest nicotine, which being at par with $W_2$ and $W_4$ differed significantly from rest of treatments.
4.3 FIELD WATER USE EFFICIENCY

Data pertaining to field water use efficiency (kg/ha/mm) worked out for the year 1993-94 and 1994-95 and average of two years as influenced by different levels of irrigation, suckercide and weedicide are presented in Table 4.17.

4.3.1 Effect of irrigation

The data on field water use efficiency given in Table 4.17 indicated that field water use efficiency was in general decreased with increased levels of irrigation during both the years as well as on average basis. The irrigation level I_1 recorded highest field water use efficiency (6.87, 8.52 and 7.75 kg/ha/mm), while the lowest field water use efficiency was recorded under I_3 (3.99, 4.96 and 4.52 kg/ha/mm) level during both the years as well as on average basis.

4.3.2 Effect of suckercide

From the data presented in Table 4.17, it was revealed that application of suckercide (S_2) increased field water use efficiency during both the years and on average basis over S_1 treatment. The suckercide pendimethalin 0.75 per cent recorded higher field water efficiency (5.64, 7.00 and 6.31 kg/ha/mm) during both the years as well as on pooled basis than hand desuckering (S_1).
Table 4.17: Water use efficiency as influenced by irrigation, suckericide and weedicide treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Field water use efficiency kg/ha/mm</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1993-94</td>
<td>1994-95</td>
</tr>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>6.87</td>
<td>8.52</td>
</tr>
<tr>
<td>I2</td>
<td>5.85</td>
<td>7.80</td>
</tr>
<tr>
<td>I3</td>
<td>3.99</td>
<td>4.96</td>
</tr>
<tr>
<td>Suckericide (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>5.03</td>
<td>6.45</td>
</tr>
<tr>
<td>S2</td>
<td>5.64</td>
<td>7.00</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>4.66</td>
<td>6.29</td>
</tr>
<tr>
<td>W2</td>
<td>5.20</td>
<td>6.66</td>
</tr>
<tr>
<td>W3</td>
<td>6.08</td>
<td>7.47</td>
</tr>
<tr>
<td>W4</td>
<td>5.08</td>
<td>6.36</td>
</tr>
<tr>
<td>W5</td>
<td>5.41</td>
<td>6.83</td>
</tr>
</tbody>
</table>

4.3.3 Effect of weedicide

Data presented in Table 4.17 indicated that field water use efficiency was higher (6.08, 7.47 and 6.82 kg/ha/mm) under treatment W3, while the lower (4.66, 6.29 and 5.52 kg/ha/mm) values were recorded under local practice of weed management during both the years as well as on average basis.
4.4 ECONOMICS

The details regarding net realization and CBR as influenced by different levels of irrigation, suckericide and weedicide and their combinations are presented in Tables 4.18 and 4.19.

4.4.1 Effect of irrigation

Data presented in Table 4.18 clearly revealed that the maximum net return of Rs. 15291/ha was obtained with the irrigation level I2 (1.1 IW/CPE ratio), while the lowest net return of Rs. 10102/ha was recorded with I1 (0.7 IW/CPE ratio). The per cent increase in net realization under I2 level of irrigation was 40.35 and 51.37 over I3 and I1 levels of irrigation, respectively. Irrigating the crop at 1.1 IW/CPE ratio (I2) also gave the higher CBR (1:2.06) in comparison to I1 (1:1.73) and I3 (1:1.72) treatments.

4.4.2 Effect of suckericide

There was an increase in the net realization as well as in the CBR due to chemical desuckering as shown in Table 4.18. The highest net realization of Rs. 13022/ha was obtained with treatment S2, while the lowest value (Rs. 11170/ha) was recorded with treatments S1. The net realization under S2 treatment was increased to the tune of 16.58 per cent over S1. It was also apparent from the data that the treatment S2 (0.75 per cent pendimethalin) gave
Table 4.18: Realization, average cost of production, cost benefit ratio, for irrigation, suckercide and weedicide treatments (Pooled basis)

| Treatment | Yield (kg/ha) | Cost of production (¥/ha) | Realization Gross (¥/ha) | Realization Net (¥/ha) | CBR  
|------------|---------------|--------------------------|--------------------------|------------------------|------
| Irrigation |               |                          |                          |                        |      
| I₁         | 2907          | 13882                    | 23984                    | 10102                  | 1:1.73 |
| I₂         | 3609          | 14482                    | 29773                    | 15291                  | 1:2.06 |
| I₃         | 3161          | 15182                    | 26077                    | 10895                  | 1:1.72 |
| Suckercide |               |                          |                          |                        |      
| S₁         | 3085          | 14280                    | 25450                    | 11170                  | 1:1.78 |
| S₂         | 3366          | 14750                    | 27772                    | 13022                  | 1:1.88 |
| Weedicide  |               |                          |                          |                        |      
| W₁         | 2946          | 14065                    | 24303                    | 10238                  | 1:1.73 |
| W₂         | 3187          | 14410                    | 26292                    | 11882                  | 1:1.82 |
| W₃         | 3637          | 15043                    | 30008                    | 14965                  | 1:1.99 |
| W₄         | 3072          | 14251                    | 25343                    | 11092                  | 1:1.78 |
| W₅         | 3286          | 14804                    | 27111                    | 12307                  | 1:1.83 |

---

Cost of Weedicide:
1) Basalin 45 EC = 550 Rs./l
2) Stomp 30 EC = 450 Rs./l
the higher CBR of 1:1.88 than Si (hand desuckering) treatment (1:1.78).

4.4.3 Effect of weedicide

Data presented in Table 4.18 indicated that the highest net realization of Rs. 14965/ha was accrued under weedicide Wa which also gave the highest CBR of 1:1.99. This treatment increased the net realization to the tune of 46.17 per cent over local practice of weed management (Wi). The next best treatment was Ws which recorded the net realization of Rs. 12307/ha with CBR of 1:1.83. The local practice of weed management lagged behind all other weedicides and recorded the net realization of Rs. 10238/ha with CBR of 1:1.73.

4.4.4 Interaction effect

The economics of different treatment combinations (pooled basis) are presented in Table 4.19.

Data given in Table 4.19 revealed that the highest net realization of Rs. 19281/ha as well as the highest CBR of 1:2.26 was recorded with the treatment combination I2S2W3 followed by I2S1W3, which recorded the net realization of Rs. 17062/ha and CBR of 1:2.15.
### Table 4.19: Economics of different treatment combinations (Pooled)

<table>
<thead>
<tr>
<th>Treatment Combination</th>
<th>Yield (kg/ha)</th>
<th>Valuation (Rs/kg)</th>
<th>Gross realization (Rs/ha)</th>
<th>Cost of production (Rs/ha)</th>
<th>Net realization (Rs/ha)</th>
<th>CBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I₁S₁W₁</td>
<td>2504</td>
<td>8.25</td>
<td>20658</td>
<td>13197</td>
<td>7461</td>
<td>1:1.57</td>
</tr>
<tr>
<td>2. I₁S₁W₂</td>
<td>2740</td>
<td>8.25</td>
<td>22605</td>
<td>13542</td>
<td>9063</td>
<td>1:1.67</td>
</tr>
<tr>
<td>3. I₁S₁W₃</td>
<td>3122</td>
<td>8.25</td>
<td>25756</td>
<td>14175</td>
<td>11581</td>
<td>1:1.82</td>
</tr>
<tr>
<td>4. I₁S₁W₄</td>
<td>2569</td>
<td>8.25</td>
<td>21194</td>
<td>13383</td>
<td>7811</td>
<td>1:1.58</td>
</tr>
<tr>
<td>5. I₁S₁W₅</td>
<td>2813</td>
<td>8.25</td>
<td>23207</td>
<td>13936</td>
<td>9271</td>
<td>1:1.67</td>
</tr>
<tr>
<td>6. I₁S₂W₁</td>
<td>2825</td>
<td>8.25</td>
<td>23315</td>
<td>13667</td>
<td>9648</td>
<td>1:1.71</td>
</tr>
<tr>
<td>7. I₁S₂W₂</td>
<td>3047</td>
<td>8.25</td>
<td>25138</td>
<td>14012</td>
<td>11126</td>
<td>1:1.79</td>
</tr>
<tr>
<td>8. I₁S₂W₃</td>
<td>3438</td>
<td>8.25</td>
<td>28364</td>
<td>14645</td>
<td>13719</td>
<td>1:1.94</td>
</tr>
<tr>
<td>9. I₁S₂W₄</td>
<td>2921</td>
<td>8.25</td>
<td>24098</td>
<td>13853</td>
<td>10245</td>
<td>1:1.74</td>
</tr>
<tr>
<td>10. I₁S₂W₅</td>
<td>3092</td>
<td>8.25</td>
<td>25509</td>
<td>14406</td>
<td>11103</td>
<td>1:1.77</td>
</tr>
<tr>
<td>11. I₂S₁W₁</td>
<td>3160</td>
<td>8.25</td>
<td>26070</td>
<td>13797</td>
<td>12273</td>
<td>1:1.88</td>
</tr>
<tr>
<td>12. I₂S₁W₂</td>
<td>3416</td>
<td>8.25</td>
<td>28182</td>
<td>14142</td>
<td>14040</td>
<td>1:1.99</td>
</tr>
<tr>
<td>13. I₂S₁W₃</td>
<td>3859</td>
<td>8.25</td>
<td>31837</td>
<td>14775</td>
<td>17062</td>
<td>1:2.15</td>
</tr>
<tr>
<td>14. I₂S₁W₄</td>
<td>3403</td>
<td>8.25</td>
<td>28075</td>
<td>13983</td>
<td>14092</td>
<td>1:2.00</td>
</tr>
<tr>
<td>15. I₂S₁W₅</td>
<td>3552</td>
<td>8.25</td>
<td>29304</td>
<td>14536</td>
<td>14768</td>
<td>1:2.02</td>
</tr>
<tr>
<td>16. I₂S₂W₁</td>
<td>3440</td>
<td>8.25</td>
<td>28380</td>
<td>14267</td>
<td>14113</td>
<td>1:1.99</td>
</tr>
<tr>
<td>17. I₂S₂W₂</td>
<td>3692</td>
<td>8.25</td>
<td>30459</td>
<td>14612</td>
<td>15847</td>
<td>1:2.08</td>
</tr>
<tr>
<td>18. I₂S₂W₃</td>
<td>4185</td>
<td>8.25</td>
<td>34526</td>
<td>15245</td>
<td>19281</td>
<td>1:2.26</td>
</tr>
<tr>
<td>19. I₂S₂W₄</td>
<td>3653</td>
<td>8.25</td>
<td>29312</td>
<td>14453</td>
<td>14859</td>
<td>1:2.03</td>
</tr>
<tr>
<td>20. I₂S₂W₅</td>
<td>3828</td>
<td>8.25</td>
<td>31581</td>
<td>15006</td>
<td>16575</td>
<td>1:2.10</td>
</tr>
<tr>
<td>21. I₃S₁W₁</td>
<td>2671</td>
<td>8.25</td>
<td>22036</td>
<td>14497</td>
<td>7539</td>
<td>1:1.52</td>
</tr>
<tr>
<td>22. I₃S₁W₂</td>
<td>3003</td>
<td>8.25</td>
<td>24775</td>
<td>14842</td>
<td>9933</td>
<td>1:1.66</td>
</tr>
<tr>
<td>23. I₃S₁W₃</td>
<td>3558</td>
<td>8.25</td>
<td>29354</td>
<td>15475</td>
<td>13879</td>
<td>1:1.89</td>
</tr>
<tr>
<td>24. I₃S₁W₄</td>
<td>2827</td>
<td>8.25</td>
<td>23323</td>
<td>14683</td>
<td>8640</td>
<td>1:1.59</td>
</tr>
<tr>
<td>25. I₃S₁W₅</td>
<td>3076</td>
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<td>25377</td>
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<td>10141</td>
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<td>26. I₃S₂W₁</td>
<td>3074</td>
<td>8.25</td>
<td>25361</td>
<td>14967</td>
<td>10394</td>
<td>1:1.69</td>
</tr>
<tr>
<td>27. I₃S₂W₂</td>
<td>3223</td>
<td>8.25</td>
<td>26590</td>
<td>15312</td>
<td>11278</td>
<td>1:1.73</td>
</tr>
<tr>
<td>28. I₃S₂W₃</td>
<td>3662</td>
<td>8.25</td>
<td>30212</td>
<td>15945</td>
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<td>1:1.89</td>
</tr>
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<td>29. I₃S₂W₄</td>
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<td>26054</td>
<td>15153</td>
<td>10901</td>
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<tr>
<td>30. I₃S₂W₅</td>
<td>3356</td>
<td>8.25</td>
<td>27687</td>
<td>15706</td>
<td>11981</td>
<td>1:1.76</td>
</tr>
</tbody>
</table>
4.5 RESIDUAL TOXICITY OF WEEDICIDES ON SUMMER GREENGRAM

To study the residual effect of weedicides applied to tobacco crop, the greengram was used as a test crop. The germination count and dry weight were recorded at 8 and 15 DAS, respectively. The data are presented in Table 4.20.

4.5.1 Germination percentage

Data pertaining to germination per cent under different treatments presented in Table 4.20 showed that there was no significant influence of different weedicide treatments on germination per cent of greengram. Though there were no significant differences in germination of greengram numerically the highest germination percentage of greengram was noticed under the treatment Wi (local practice), while fluchloralin 1.5 lit/ha (W3) followed by pendimethalin 1.5 lit/ha (Ws) recorded lower germination percentage than other treatments.

4.5.2 Dry weight of plant

Data regarding dry weight of plants (g/pot) recorded at 15 DAS (Table 4.20) showed nonsignificant differences due to different weedicides. This indicated that there was no adverse effect of weedicides on plant growth of succeeding crop. The maximum dry weight of greengram was recorded under the treatment Wi, while fluchloralin 1.5 lit/ha (W3) resulted in the lowest dry weight of greengram plants.
Table 4.20: Residual effect of weedicides on germination and dry weight of summer greengram

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination per cent</th>
<th>Dry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation (I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I₁</td>
<td>80.43</td>
<td>80.90</td>
</tr>
<tr>
<td>I₂</td>
<td>80.60</td>
<td>81.30</td>
</tr>
<tr>
<td>I₃</td>
<td>79.53</td>
<td>79.78</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.48</td>
<td>0.44</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Suckricide (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₁</td>
<td>80.50</td>
<td>81.05</td>
</tr>
<tr>
<td>S₂</td>
<td>79.87</td>
<td>80.27</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.39</td>
<td>0.36</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>4.53</td>
<td>4.11</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W₁</td>
<td>80.88</td>
<td>81.39</td>
</tr>
<tr>
<td>W₂</td>
<td>80.46</td>
<td>80.89</td>
</tr>
<tr>
<td>W₃</td>
<td>79.50</td>
<td>79.85</td>
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<tr>
<td>W₄</td>
<td>80.17</td>
<td>80.73</td>
</tr>
<tr>
<td>W₅</td>
<td>79.92</td>
<td>80.43</td>
</tr>
<tr>
<td>S.Em.±</td>
<td>0.72</td>
<td>0.78</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>5.29</td>
<td>5.67</td>
</tr>
<tr>
<td>Sign. Int.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
DISCUSSION
The present investigation was undertaken to study the effects of moisture regime, suckericide and weedicide on growth, yield and quality of rustica tobacco cv. GC 2. The results presented in the preceding chapter have been discussed hereunder in light of cause and effect relationship as far as possible and these have been supported by the relevant findings reported by other researchers.

Growth and development of crop plants are directly related to their genetic constitution. Apart from genetic influence, environmental factors and cultural practices do influence the growth and development of plants by way of their direct and indirect roles in different metabolic processes. Among the factors known to determine the crop yield, judicious use of irrigation water coupled with proper fertilization is considered as pivotal to achieve potential production. Water management studies have become an integral part of research for irrigated crops. Because, it being a prime mover, affects basic processes like nutrient transformation, uptake, transport and utilization from the soil by plants. Thus, contribution of irrigation water in increasing crop productivity is next to
fertilizer. However, use efficiency of both these inputs is low. Hence, water management can improve the use efficiency in terms of economic response to a significant level. Besides, topping and desuckering are very important operations in tobacco production. Both these operations, if followed in time, ensure higher yields and better quality of the produce. Chemical sucker control not only improves the yield but quality too and makes tobacco cultivation more economical. Further, uncontrolled weeds reduce tobacco yield and deteriorate the leaf quality. Keeping all these points in view, present investigation was undertaken. The salient findings are discussed as under:

5.1 EFFECT OF CLIMATE

The weather details, temperature, relative humidity, evaporation, sunshine hours and rainfall for the years 1993-94 and 1994-95, during which the present investigation was conducted, are presented in Table 3.2 and 3.3 and also depicted in Fig. 3.1 and 3.2. Data revealed that 1994-95 crop season was, in general, favourable for tobacco crop. The higher yield of tobacco in 1994-95 appeared to be related to more favourable weather conditions, particularly low temperature. Tobacco is cold loving crop, hence reduced temperature (8.10°C) during growth stages was favourable for higher cured leaf yield during the year 1994-95 (3409 to 4291 kg/ha) as
compared to 1993-94 (2405 to 2927 kg/ha). However, this favourable effects had not influenced the trend or performance of treatments. During 1993-94 in the second week of January 21.8 mm rainfall was received, which is not likely to affect the growth and yield of tobacco, but it had favoured orobanche infestation which may be the prime cause for the lower yield during 1993-94 compared to 1994-95.

5.2 EFFECT OF IRRIGATION

Growth and development of a plant depend on the differentiation and expansion of cell components until the characteristic form of the plant is realised. All the plant processes are taking place in effective aqueous medium and since, water is involved as a transporting agent or a reagent, it is not surprising that optimum water supply holds promoting effects on these physiological processes and consequently on plant growth.

5.2.1 Growth attributes

The plant height recorded at almost all the stages was (60, 90 and 120 DAP) increased significantly by different irrigation levels during both the years of experimentation as well as on the pooled basis (Table 4.1). The results amply indicated that treatment I2 (1.1 IW/CPE ratio) had significantly improved the plant height over I3 (1.5 IW/CPE ratio) and I1 (0.7 IW/CPE ratio) levels of
irrigation during both the years. In pooled analysis at 60 DAP, I2 and I3 were at par, but were significantly superior to I1. Similar increases in the plant height due to different IW/CPE ratios were reported by Ramachandram et al. (1984) in case of FCV tobacco. The work carried out at BTRS, Anand also indicated similar progressive increase in plant height with increase in irrigation levels (Anon., 1990-91b).

In the present investigation, IW/CPE ratio at increasing levels from 0.7 to 1.1 progressively increased leaf length and leaf width at all the stages of growth (Table 4.2 and 4.3). The results revealed that treatment I2 (1.1 IW/CPE ratio) registered the highest values for leaf length and width, which were significantly more than I1 and I3 levels of irrigation. Thus, it is obvious from the above results that the response to applied irrigation was linear up to 1.1 IW/CPE ratio. Similar increases in leaf length and width have been reported by several workers in different types of tobacco (Anon., 1990-91b and Patel et al., 1992b).

5.2.2 Fresh weight of suckers

Sucker (axillary growth) directly and adversely affects the cured leaf yield and also deteriorates the tobacco leaf quality (Patel et al., 1978; Bangarayya et al., 1982; Bhat et al., 1990 and Chavda et al., 1991). Simultaneously it adds to the cost of tobacco production as
it has to be checked either manually or through chemicals (Patel et al., 1987).

Increase in vegetative growth due to irrigation (Table 4.6) would obviously increase the suckers growth. The data presented in Table 4.6 clearly indicated significant progressive increase in suckers weight due to increase in the irrigation levels during both the years as well as on the pooled basis. The data (Table 4.6) on the pooled basis revealed that the increase in sucker biomass was to the extent of 13 and 24 per cent under I₂ and I₃ levels, respectively over I₁. This could be attributed to increase in the overall vegetative growth, which is likely to increase the rate of photosynthesis. The axil from which the suckers come being closest to the source (leaf), photosynthates are received by the sink and thus there is an increase in sucker biomass with increasing levels of irrigation. Therefore, suckers are considered as competitive sink for assimilates from the adjacent leaves (Alquaiza and Zamora, 1987).

5.2.3 Yield and quality

It is evident from the data presented in Table 4.5 that the cured leaf yield of tobacco during both the years as well as on the pooled basis showed significant differences due to irrigation levels. The data on pooled basis revealed that the increase in cured leaf yield was to
the extent of 19 and 12 per cent under I2 (1.1 IW/CPE ratio) over I1 and I3, respectively. The increase in cured leaf yield could be attributed to increase in plant height, leaf length and width (Table 4.1, 4.2 and 4.3). The results further indicated that 1.1 IW/CPE ratio (I2) seemed to be an optimum level as decline in the yield at 1.5 IW/CPE ratio (I3) was noticed. The decrease in yield at I3 was to the tune of 12.4 per cent over I2. Similarly, Patel et al. (1992b) have also reported from an experiment on scheduling irrigation for rustica tobacco for middle Gujarat conditions that 1.1 IW/CPE ratio at 50 mm water depth was optimum. They have showed that maximum yield and the highest monetary returns could be obtained by irrigating tobacco at 1.1 IW/CPE ratio. Similar increases in cured leaf yield by irrigating the crop at 1.1 IW/CPE ratio were also recorded at BTRS, Anand (Anon., 1988–89 b and Anon., 1990–91).

5.2.4 Spangle and growth scores

The spangling in tobacco is considered as the quality trait which was significantly affected by the levels of irrigation. Irrigating the crop at 1.1 IW/CPE ratio was found to be an optimum level. The growth score was closely related with cured leaf yield and hence it is an important yield attribute. The IW/CPE ratio of 1.1 gave significantly higher value of growth score than I1 and I3 levels. The highest growth score under intermediate moisture regime
(I2) clearly indicates that the rustica tobacco does not love wet footing (higher available moisture).

5.2.5 Dry weight of weeds

A perusal of the results on dry weight of weeds (Table 4.9) revealed significant effect of irrigation levels during second year and on the pooled basis. The IW/CPE ratio of 1.5 gave the highest dry weight of weeds during 1994-95 and on pooled basis. Thus, data clearly indicated that as the irrigation frequency increases, there is an increase in weed population. The increase in dry weight of weeds could be due to germination of dormant weed seeds under higher frequency irrigation (I3) and also due to continuous growth of weeds under moist condition.

5.2.6 Orobanche weight

The orobanche is a root parasite which debilitates tobacco plants severely resulting into stunted growth and reduced yields. The loss in yield and quality of leaf is very much variable from 24 to 52% (Anon., 1989). The growth and development as well as yield and physico-chemical qualities of cigarette tobacco were greatly reduced by orobanche infestation (Krishnamurty et al., 1977). Murthy and Nagarajan (1986) also reported similar findings.
Increase in number of irrigations due to higher IW/CPE ratio would obviously increase the weight of orobanche. The data presented in Table 4.15 clearly indicated significant progressive increase in orobanche weight due to increase in number of irrigations during 1994-95 as well as on the pooled basis. Although treatment differences were not significant during 1993-94, increase in weight of orobanche with increasing levels of irrigation was noticed. It was felt that soil moisture during the emergence period played a significant role compared to initial infestation in the field. Thus, if moisture is controlled, population of orobanche could be controlled. Similarly, Khot (1974) reported that orobanche were least in unirrigated plots, whereas they were maximum in normally irrigated plots of bidi tobacco.

5.2.7 Chemical constituents

Among different constituents present in tobacco leaf, nitrogenous constituents viz., total-N, nicotine and nor-nicotine occupy a unique position. Felipe and Long (1988) reported that leaves with excessive nitrogenous constituents are chemically imbalanced (especially reducing sugar/nicotine), dark in colour, dry and chaffy. Likewise, Tso (1972) noted that the ratio of total-N to nicotine should be less than 1.00 and the ratio of water soluble-N to total-N should be more than 0.65 for a desirable quality of
flue-cured tobacco. However, in case of non-FCV tobacco higher nitrogenous constituents are considered as quality traits (Patel et al., 1989).

Nitrogenous constituents viz., total-N and nicotine were significantly affected by levels of irrigation (Table 4.16). Among different levels, 0.7 IW/CPE ratio (I₁) indicated highest values for both of the constituents, which were significantly more than I₂ (1.1 IW/CPE ratio) and I₃ (1.5 IW/CPE ratio). The application of irrigation at higher rates (1.5 IW/CPE ratio) showed decline in the nitrogenous constituents. The decrease in nitrogenous constituent upto I₂ could probably due to dilution effect as there was increase in yield by about 24 per cent over I₁ (Table 4.5), but the decrease at higher level of applied irrigation i.e. I₃ could be due to leaching of applied nitrogen in form of NO₃-N beyond maximum feeding zone of the roots.

5.2.8 Field water use efficiency

Water use efficiency refers largely to the production of economic produce of a crop per unit of water used by it throughout the life of a crop.

Data presented in Table 4.17 indicated remarkable differences in field water use efficiency under different IW/CPE ratio during both the years as well as on pooled basis. The higher field water use efficiency was observed
under the treatment of IW/CPE ratio 0.7 (6.87, 8.52 and 7.75) than 1.1 (5.85, 7.80 and 6.87) and 1.5 (3.99, 4.96 and 4.52). The decrease in field water use efficiency under I2 over I1 could probably due to about 57 per cent increase water used as against 19 per cent increase in the cured leaf yield over I1. The drastic reduction in the field water use efficiency under I3 over other two levels of irrigation could be due to the reduction in yield at I3 over I2. These results clearly indicate that rustica tobacco do not love wet-foot conditions (high moisture availability).

5.3 EFFECT OF SUCKERICIDE

It is recapitulated from the review that good number of suckericides, both systemic and contact types have been recommended for the control of suckers (Collins et al., 1970 and Smith et al., 1971). The chemicals having the property of killing axillary buds by contact such as Accotab and Penar have been successfully used in the control of suckers in tobacco (Bangarayya et al., 1977 and Patel et al., 1978).

5.3.1 Growth attributes

In the present investigation pendimethalin was used @ 0.75 per cent concentration and was compared with hand desuckering.
Data on the plant height showed significant differences due to suckericide during 1993-94 and on the pooled basis, while such was not the case during 1994-95 (Table 4.1). Among two treatments, $S_2$ (pendimethalin 0.75 per cent) indicated higher plant height than $S_1$ (hand desuckering).

The results revealed that application of suckericide (Pendimethalin 0.75 per cent) significantly increased the leaf length and leaf width during 1994-95 and on the pooled basis over hand desuckering. The first year (1993-94) results failed to indicate such variation. The increase in the growth attributes like leaf length and width could be due to considerable reduction in the fresh weight of suckers (Table 4.6), which might have helped in the translocation of photosynthates to the leaf sink rather than to the suckers. Similar increases in growth attributes due to application of suckericide have been reported by several workers (Seltrannet el al., 1969; Kittrell et al., 1972; Patel et al., 1978; Bangarayya et al., 1982 and 1988; Patel et al., 1990; Bhat et al., 1990 and Chavda et al., 1991).

5.3.2 Fresh weight of suckers

Application of suckericide (Pendimethalin) was significantly effective in reducing the fresh weight of suckers as compared to hand desuckering during both the seasons of experimentation as well as in the combined
analysis (Table 4.6). The decrease in sucker weight was to the extent of 7.32 per cent under S2 (Pendimethalin) over S1 (hand desuckering). Similar depressing effect on sucker growth due to pendimethalin over hand desuckering has been reported by several workers (Bangarayya et al., 1982; Patel et al., 1990; Chavda et al., 1991 and Stojkov et al., 1993).

5.3.3 Yield and quality

The suckercide used has proved effective in obtaining higher cured leaf yield of tobacco over hand desuckering (Table 4.5) during both the year as well as on the pooled basis. On the pooled basis, the extent of increase in yield was 8.36 per cent with S2 (Pendimethalin) over that of S1 (hand desuckering). The increase in cured leaf yield due to suckercide treatment could probably be due to the significant reduction in fresh weight of suckers (Table 4.6). The reduction in the sucker biomass might have helped in greater absorption of nutrients under S2 treatment. This in turn might have helped in greater assimilation of photosynthates in the leaf and thereby increase in the yield. Such positive and beneficial effects of suckercide on cured leaf yield of tobacco were observed by several workers (Marshall and Seltman, 1964; Patel et al., 1978; Bangarayya et al., 1982 and 1988; Patel et al., 1990; Janardhan et al., 1990; Bhat et al., 1990 and Chavda et al., 1991).
5.3.4 Spangle and growth scores

The significant effect of suckercide on spangle score was observed during both the years as well as on pooled basis. The maximum spangle score was recorded in pendimethalin (S2) treatment.

Among two treatments, S2 proved its superiority by producing higher values of growth score during 1993-94 and in pooled analysis, while it was found to be non-significant during 1994-95. The improvement in the growth score was due to increase in leaf dimensions like length and width (Table 4.2 and 4.3).

5.3.5 Dry weight of weeds

Dry weight of weeds was significantly decreased due to suckercide application over hand desuckering during 1994-95, but in the combined analysis and during 1993-94 the differences were non-significant. Although difference was significant during 1994-95 the decrease in dry weight of weeds was insignificant (less than 0.7 per cent).

5.3.6 Orobanche weight

The data presented in Table 4.15 on orobanche weight indicated that there was significant effect pendimethalin application on the reduction (16.8 per cent) orobanche during 1994-95. During 1993-94 and on the
basis though results were non significant the reduction in orobanche weight was 25.9 and 21.6 per cent, respectively. These data indicate that though pendimethalin is a suckercide it has been translocated into the plant system and orobanche being obligate root-parasite, its germination and subsequent growth was arrested. The experiment conducted at CTRI, Rajahmundry on the control of orobanche through spray application of glyphosate, a broad spectrum weedicide, @ 0.025 and 0.05 per cent has also shown encouraging results in the control of orobanche (Anon., 1995).

5.3.7 Chemical constituents

Bangarayya et al. (1982) and Patel et al. (1990) did not find significant effect of suckericidal treatments on the nitrogenous constituents of tobacco. However, in the present investigation, significant differences in total-N and nicotine contents were noted (Table 4.16). The data clearly indicated that application of suckercide (pendimethalin) had decreased the concentration of total nitrogen and improved the concentration of nicotine. The improvement in nicotine content of leaf due to the application of decanol @ 6 per cent and pendimethalin @ 0.75 per cent over hand desuckering was reported by Chavda et al. (1991) in case of bidi tobacco.
5.3.8 Field water use efficiency

Considerable increase in field water use efficiency with the application of suckericide was observed during both the years as well as on pooled basis (Table 4.17). The higher field water use efficiency was observed under the treatment of pendimethalin 0.75 per cent (5.64, 7.0 and 6.31) than hand desuckering (5.03, 6.45 and 5.78) during both the years and in combined analysis. The increase in field water use efficiency due to application of suckericide was attributed to its favourable effect on cured leaf yield.

5.4 EFFECT OF WEEDICIDE

The production potential of any crop depends on number of factors one of them is weed management, which interacts with agroclimatic conditions prevailing at a particular place. Weeds not only reduce yield by competing with crop for moisture, light, plant nutrients and space but also interfere in harvesting and drying of tobacco leaf.

5.4.1 Growth attributes

Perusal of the data presented in Table 4.1 indicated that weedicide treatment had significantly increased the height of tobacco plant at 60 and 120 DAP during the years 1994-95 and 1993-94, respectively. Similarly, the height at 60 DAP on pooled basis was also
improved significantly by weedicide treatments. Overall, all above conditions W3 treatment (Fluchloralin 1.5 lit/ha) showed its superiority over other treatments.

The data presented in Table 4.2 indicated that application of fluchloralin @ 1.5 lit/ha progressively increased the leaf length but the trend was not consistent. However, at 90 and 120 DAP during 1994-95 the differences were significant. In case of pooled analysis, significant differences were noticed at 60, 90 and 120 DAP but the levels of weedicides tried were at par with each other.

The improvement in leaf width was observed due to weedicide treatments during 1994-95 and on pooled basis, while during 1993-94 the differences were not significant (Table 4.3). Among all the weedicides treatments, W3 (Fluchloralin 1.5 lit/ha) showed its superiority over others. The improvement in the growth attributes could be due to significantly lower dry weight of weeds under this treatment than others (Table 4.9). Further, at a very low concentration weedicides have been reported to stimulate the growth, which might have resulted in an improvement in growth score.

5.4.2 Fresh weight of suckers

The fresh weight of suckers was not significantly affected by any of the weedicide treatments during both the years as well as in the pooled analysis. Non-significant
effect of weedicide on sucker weight might be due to their application into soil along with irrigation, which does not provide enough concentration for checking axillary growth.

5.4.3 Yield and quality

Perusal of the results of cured leaf yield (Table 4.5) revealed significant effect of weedicide application during both the years as well as on the pooled basis. The application of fluchloralin @ 1.5 lit/ha (W₃) was found to be an optimum level. The increase in yield over local practice (W₁) was to the tune of 30.7, 18.8 and 23.5 per cent during 1993-94, 1994-95 and on the pooled basis. The decrease in yield under local practice of weed management (W₁) over other treatments was due to the fact that this treatment recorded maximum dry weight of weeds (Table 4.9), which clearly showed the severe weed crop competition. Uncontrolled weeds were reported to reduce tobacco yield by 57% (Raghavaiah et al., 1980) on irrigated light soils, as they compete for light, moisture, nutrients and space. The present findings are in confirmation with those reported earlier by Raghavaiah et al. (1985) and Krishnamurthy et al. (1991) on other types of tobacco.

5.4.4 Spangle and growth scores

The data on spangling intensity and growth score indicated non-significant variation due to different weedicide treatments.
5.4.5 Dry weight of weeds

Data on dry weight of weeds indicated significant reduction in it by application of fluchloralin @ 1.5 lit/ha (W3) over other weedicide levels (Table 4.9) during both the years as well as in pooled analysis. The higher dry weight of weeds was recorded with local practice (W1) treatment. Though significant differences were observed in different treatments, the W4 and W2 levels were at par. A significant reduction in weed density and weed biomass was also observed by herbicides as compared to unweeded check by Raghavaiah and Sannibabu (1986), Raghavaiah and Subbarao (1986) and Krishnamurthy et al. (1991) in other types of tobacco.

5.4.6 Orobanche weight

In the present study, the orobanche weight was not significantly affected by any of the weedicide treatments during both the years as well as in the pooled analysis. However, the minimum orobanche weight was observed in W2 followed by W3 treatments i.e. application of fluchloralin @ 1.0 and 1.5 lit/ha, respectively. These results closely resembled with those of Palled et al., (1985), who found that among the herbicides, pebulate and fluchloralin each at 3.0 kg/ha reduced orobanche infestation significantly and they were superior to hoeing treatment.
5.4.7 Chemical constituents

Among different nitrogenous constituents total-N was significantly decreased with the application of weedicides during 1993-94 and in pooled analysis. The lowest total-N was observed in Ws treatment, while the highest content was observed with local practice (Wi treatment). In case of nicotine content significant differences were found due to weedicide treatments in pooled analysis only. Local practice i.e. hand weeding till the crop permitted followed by weeding (Wi) recorded highest leaf nicotine content, while a reduction in nicotine content was observed in herbicide treated plots. Similar results were also recorded by Raghavaiah and Subbarao (1986). Although there was reduction in total-N and nicotine contents of leaf lamina, the differences were not large enough to bring drastic changes in leaf quality.

5.4.8 Field water use efficiency

The results pertaining to field water use efficiency (Table 4.17) revealed that weedicide application had increased the field water use efficiency over no application or local practice. The highest field water use efficiency was recorded under the treatment of application of fluchloralin @ 1.5 lit/ha (6.08, 7.47 and 6.82) followed by application of pendimethalin @ 1.5 lit/ha (5.41, 6.83 and 6.16). The local practice registered the FWUE of 4.66, 6.29
and 5.52 during 1993-94, 1994-95 and on the pooled basis, respectively. The increase in field water use efficiency due to application of weedicide was attributed to its favourable effects on plant growth which consequently increased the cured leaf yield.

5.5 INTERACTION EFFECT

In the present study most of the interactions were found to be non-significant. But only two interactions in respect of dry weight of weeds and growth attributes (leaf width) were found significant. However, only those interactions which were found significant on the pooled basis excluding interaction effects with year, are discussed as under:

5.5.1 Interaction effect of I x W

The positive interaction effect of irrigation x weedicide was noticed on dry weight of weeds (Table 4.11). Irrigating the crop at 0.7 IW/CPE ratio with application of fluchloralin @ 1.5 lit/ha (I1W3) produced minimum dry weight of weeds. The maximum dry weight of weeds was observed when the crop was irrigated at 1.5 IW/CPE ratio with local practice i.e. interculturing till crop permitted followed by weeding (I3W1). The minimum dry weight of weeds under I1W3 treatment combination is mainly on account of minimum weed
weight recorded under I₁ among irrigation levels and W₃ treatment among weedicidal treatments (Table 4.9).

5.5.2 Interaction effect of I x S

The dry weight of weeds was significantly lower when the crop was irrigated at 0.7 IW/CPE ratio with application of pendimethalin as a suckericide (I₁S₂), while the higher values of dry weight of weeds was observed when the crop was irrigated at 1.5 IW/CPE ratio with application of pendimethalin. The decrease in dry weight of weeds under I₁S₂ treatment combination could probably due to very low dry weight of weeds under I₁ and higher concentration (0.75 per cent) of pendimethalin applied as a suckericide than weedicide (0.45 per cent).

5.5.3 Interaction effect of I x S

The positive interaction effect of irrigation x suckericide was noticed on leaf width at 60 and 90 DAP (Table 4.4). Irrigating crop at 1.1 IW/CPE ratio with the application of pendimethalin 0.75 per cent (I₂S₂) produced maximum value for leaf width.

5.5.4 Interaction effect of S x W

The positive interaction effect of suckericide x weedicide was also noticed on dry weight of weeds (Table 4.12). The minimum values for dry weight of weeds were
recorded under application of pendimethalin 0.75 per cent as a suckericide and application of fluchloralin @ 1.5 lit/ha as a weedicide (S\textsubscript{2}W\textsubscript{3}). However, this combination was at par with S\textsubscript{1}W\textsubscript{3}. The highest dry weight of weed was recorded with S\textsubscript{2}W\textsubscript{1} combination but it was at par with S\textsubscript{1}W\textsubscript{1} combination.

5.5.5 Interaction effect of I x S x W

The treatment combination I\textsubscript{1}S\textsubscript{1}W\textsubscript{3} registered the lowest dry weight of weeds (Table 4.13), which was at par with I\textsubscript{1}S\textsubscript{2}W\textsubscript{3}, but differed significantly from the rest of the treatment combinations. This may be due to less number of irrigations and application of pendimethalin (0.75 per cent) as a suckericide and fluchloralin (1.5 lit/ha) as a weedicide.

5.6 ECONOMICS

5.6.1 Effect of irrigation

Among various irrigation treatments, I\textsubscript{2} (1.1 IW/CPE ratio) recorded the highest net return to the tune of Rs. 15291/ha with CBR of 1:2.06, followed by I\textsubscript{3} (1.5 IW/CPE ratio) with Rs. 10895/ha (Table 4.18). The maximum net realization with higher CBR was also reported by Patel et al. (1992 b) in rustica tobacco. The increase in profitability was mainly due to significantly higher cured leaf yield recorded under this treatment over other treatments. Thus,
among the three levels of irrigation (0.7, 1.1 and 1.5 IW/CPE ratios) evaluated in the present study, 1.1 IW/CPE ratio was optimum for securing higher yield of rustica tobacco.

5.6.2 Effect of suckericide

In case of suckericide, S2 (application of pendimethalin 0.75 per cent) recorded the higher net return worth Rs. 13022/ha with CBR of 1:1.88 (Table 4.18) over S1 (hand desuckering). Such increase in CBR was mainly because of increase in cured leaf yield under treatment S2. Similar results were also reported by Patel et al. (1990) and Patel et al. (1992) in bidi tobacco.

5.6.3 Effect of weedicide

Among different weedicide treatments, the highest net realization to the tune of Rs. 14965/ha with CBR of 1:1.99 was recorded under W3 (fluchloralin @ 1.5 lit/ha) treatment followed by W5 (pendimethalin 1.5 lit/ha), which recorded the net realization of Rs. 12307/ha with CBR of 1:1.83 (Table 4.18).

5.6.4 Interaction effect

The treatment combination I2S2W3 registered the highest net realization of Rs. 19281/ha and CBR of 1:2.26, followed by the treatment combination I2S1W3 which recorded
the net realization of Rs. 17602/ha and CBR of 1:2.15. This may be due to the individual treatment effects of I2, S2 and W3 which recorded the highest cured leaf yield.

5.7 RESIDUAL EFFECT ON SUCCEEDING CROP

An ideal fate of herbicides in the soil is one that brings about effective control of weeds for sufficiently long period to give comparative advantage to crop but at the same time dissipates from the soil before the end of crop season so that the following crop could be planted safely. On the other hand, very rapid loss of herbicides from the soil will give poor weed control, which is considered unsatisfactory for the crop growth. Herbicide residue left over in the soil may affect germination and growth of the succeeding crop. The residual effect of herbicides was studied on summer greengram crop.

Residual effect of different treatments on germination and dry weight of seedlings (Table 4.20) indicated that germination and dry weight of seedlings of green gram crop remained unaffected due to the residue of different herbicides. Similar results were obtained by Raghavaiah and Krishnamurthy (1986) with 1.0 and 2.0 kg/ha fluchloralin and Shelby et al. (1990) with 1.7 kg/ha pendimethalin.
SUMMARY & CONCLUSIONS
VI SUMMARY AND CONCLUSION

The present investigation was carried out on loamy sand oil of BTRS Farm, Gujarat Agricultural University, Anand Campus, Anand to study the effect of moisture regimes, suckericide and weedicides on growth, yield and quality of rustica tobacco during 1993-94 and 1994-95.

The experiment was laid out in a split plot design with three levels of irrigation ($I_1 = 0.7$ IW/CPE ratio, $I_2 = 1.1$ IW/CPE ratio and $I_3 = 1.5$ IW/CPE ratio) and two levels of suckericide ($S_1 =$ hand desuckering and $S_2 = 0.75$ per cent pendimethalin) relegated to main plots and five levels of weedicide ($W_1 =$ local practice, $W_2 = $ fluchloralin 1.0 lit/ha, $W_3 = $ fluchloralin 1.5 lit/ha, $W_4 = $ pendimethalin 1.0 lit/ha, $W_5 = $ pendimethalin 1.5 lit/ha) were assigned to sub-plots. In all 30 treatment combinations were replicated four times.

The observations on yield and its attributes, fresh weight of suckers, spangle score, growth score, dry weight of weeds, weight of orobanche, net returns and CBR were recorded. The leaf lamina samples were analysed for total-N and nicotine contents to evaluate the leaf quality. The results presented and discussed in the preceding chapters are summarised as under:
6.1 EFFECT OF IRRIGATION

6.1.1 Growth attributes

Irrigation level of 1.1 IW/CPE ratio had significantly increased growth attributes viz, plant height at 60, 90 and 120 DAP in both the years and on pooled basis. Similar trend was also observed in leaf length and width at all the growth stages during both the years as well as in their combined analysis.

6.1.2 Fresh weight of suckers

Fresh weight of suckers was significantly higher under I3 (1.5 IW/CPE ratio) than I2 (1.1 IW/CPE ratio) and I1 (0.7 IW/CPE ratio) levels of irrigation during both the years as well as the pooled basis. The resultant increase in sucker weight under I3 was to the tune of 24 per cent over I1 on the pooled basis.

6.1.3 Cured leaf yield

The cured leaf yield was significantly affected during both the years as well as on pooled basis. It was significantly more under IW/CPE ratio of 1.1 (2927, 4291 and 2609 kg/ha) than 1.5 (2596, 3725 and 3161 kg/ha) and 0.7 (2405, 3409 and 2907 kg/ha) IW/CPE ratios during both the years as well as on the pooled basis.
6.1.4 Spangle and growth scores

Higher spangle and growth scores were recorded under the treatment of 1.1 IW/CPE ratio as compared to lower (0.7) and higher (1.5) levels of irrigation during both the years as well as on pooled basis.

6.1.5 Dry weight of weeds

Marked increase in dry weight of weeds was recorded with increasing levels of irrigation. Higher dry weight of weeds (734.6 and 698.2 kg/ha) was noticed under IW/CPE ratio of 1.5 during 1994-95 and on pooled basis. Although differences were non-significant during 1993-94, similar increasing trend in weight of weeds with increase in irrigation frequency was noticed.

6.1.6 Orobanche weight

Increase in number of irrigations due to higher IW/CPE ratio remarkably increased orobanche weight. Significantly higher orobanche weight was recorded under 1.5 IW/CPE ratio than 1.1 and 0.7 IW/CPE ratios during the year 1994-95 and on pooled basis. Although differences were non-significant during 1993-94, similar increasing trend in orobanche weight was noticed with increase in number of irrigations.
6.1.7 Field water use efficiency

Increasing levels of irrigation remarkably decreased the field water use efficiency. Higher field water use efficiency (6.87, 8.52 and 7.75 kg/ha/mm) was recorded under the treatment of IW/CPE ratio 0.7 as compared to higher levels of irrigation during both the years.

6.1.8 Chemical constituents

Among different levels of irrigation, 0.7 IW/CPE ratio registered highest values for total-N and nicotine contents. The application of irrigation at higher rates (1.5 IW/CPE ratio) showed decreasing trend in both these quality constituents.

6.1.9 Monetary returns

The highest net realization of Rs. 15291/ha was recorded under 1.1 IW/CPE ratio, followed by 1.5 IW/CPE ratio, which accrued net realization of Rs. 10895/ha. The highest CBR of 1:2.06 was noted under I2, followed by CBR of 1:1.73 under I1 treatment.

6.2 EFFECT OF SUCKERICIDE

6.2.1 Growth attributes

Application of pendimethalin® 0.75 per cent (S2) significantly improved plant height over hand desuckering (S1) during 1993-94 and on the basis of combined analysis.
Similarly, leaf length and width measured at 60, 90 and 120 DAP also showed significant improvement due to suckericidal treatment over hand desuckering during the year 1994-95 and on the pooled basis.

6.2.2 Fresh weight of suckers

Application of pendimethalin @ 0.75 per cent significantly reduced fresh weight of suckers over hand desuckering during both the seasons as well as on the pooled basis. There was decrease in sucker weight to the extent of 7.32 per cent under S2 over S1.

6.2.3 Cured leaf yield

The cured leaf yield was significantly improved due to suckericidal treatment (S2) over hand desuckering (S1). The increase in the cured leaf yield under S2 was to the tune of 8.36 per cent over S1.

6.2.4 Spangle and growth score

The spangling and growth score were significantly increased due to the use of chemical suckercide over hand desuckering. Pendimethalin @ 0.75 per cent gave significantly higher spangle and growth scores than hand desuckering.
6.2.5 Dry weight of weeds

The suckericide application did not manifest its significant influence on dry weight of weeds during 1993-94 and in pooled analysis. However, during 1994-95 the dry weight of weeds was significantly lower under S2 than S1.

6.2.6 Orobanche weight

Orobanche weight was significantly decreased with the application of pendimethalin @ 0.75 per cent during 1994-95 over hand desuckering. Though results were non significant during 1993-94 and on the pooled basis, the similar reduction in orobanche weight was noticed.

6.2.7 Field water use efficiency

Application of suckericide remarkably increased field water use efficiency (5.64 7.00 and 6.31 kg/ha/mm) as compared to hand desuckering (5.03, 6.45 and 5.78).

6.2.8 Chemical constituents

Application of pendimethalin (0.75 per cent) remarkably decreased the concentration of total nitrogen and increased the concentration of nicotine in leaf lamina as compared to hand desuckering.
6.2.9 Monetary returns

The higher net realization of Rs. 13022/ha and CBR of 1:1.88 was recorded under pendimethalin application than hand desuckering which recorded net realization of Rs.11170/ha and CBR of 1:1.78.

6.3 EFFECT OF WEEDICIDE

6.3.1 Growth attributes

Among growth attributes, maximum plant height, leaf length and leaf width were recorded under application of fluchloralin @ 1.5 lit/ha at 60, 90 and 120 DAP during both the years as well as on pooled basis.

6.3.2 Fresh weight of suckers

The fresh weight of suckers was not significantly influenced by weedicide application during both the years as well as on pooled basis. However, higher sucker weight was observed due to application of weedicide over local practice.

6.3.3 Cured leaf yield

Significantly more cured leaf yield was obtained from application of fluchloralin @ 1.5 lit/ha during both the years as well as on the basis of pooled results than other weedicidal treatments including local practice.
6.3.4 Spangle and growth scores

The spangle and growth scores remained unaffected due to different weedicide treatments during both the years and on pooled basis.

6.3.5 Dry weight of weeds

The results revealed that application of weedicide (fluchloralin @ 1.5 lit/ha) remarkably decreased the dry weight of weeds over other weedicide levels. The local practice of weed management recorded the highest dry weight of weeds.

6.3.6 Orobanche weight

Orobanche weight was not significantly influenced by weedicide application during both the years and in pooled results. However, the lowest orobanche weight was observed under the application of fluchloralin @ 1.0 kg/ha followed by 1.5 kg/ha.

6.3.7 Field water use efficiency

Field water use efficiency was highest under treatment $W_3$ (fluchloralin 1.5 lit/ha) followed by the treatment $W_5$ (pendimethalin 1.5 lit/ha), while it was lowest under the treatment $W_1$ (local practice).
6.3.8 Chemical constituents

On the basis of pooled results significant decrease in total-N and nicotine contents of leaf lamina was noticed, the differences were not great to modifying the leaf quality significantly.

6.3.9 Monetary returns

Fluchloralin applied @ 1.5 lit/ha recorded the highest net realization of Rs. 14965/ha with CBR of 1:1.99, followed by application of pendimethalin @ 1.5 lit/ha with net realization of Rs. 12307/ha and CBR of 1:1.83.

6.4 RESIDUAL EFFECT ON SUCCEEDING CROP

The study revealed that summer green gram crop was not significantly affected by the left over residues of different herbicides applied to preceding tobacco crop.

6.5 INTERACTION EFFECTS

The interaction I x S exhibited significant effects on leaf width, wherein the treatment combination I2S2 registered the highest values for leaf width at 60 and 90 DAP during 1994-95.

Similarly, I x W, I x S, S x W and I x S x W interactions showed their significant effect on dry weight of weeds. The treatment combinations I1W3, I1S2, S2W3 and
I1S1W3 in I x W, I x S, S x W and I x S x W interactions, respectively registered significantly lower dry weight of weeds than the rest of the treatment combinations.

The treatment combination I2S1W3 given the highest net realization and CBR.

CONCLUSION

Based on the two years (1993-94 and 1994-95) results, it could be concluded that for securing the highest yield and net return, the rustica tobacco crop (cv. GC 2) grown under middle Gujarat Agroclimatic Zone III should be provided 10 to 11 irrigations of 50 mm depth (IW/CPE ratio 1.1), chemically desuckered with 0.75 per cent pendimethalin and for keeping minimum weed population at the time of harvesting, fluchloralin @ 1.5 lit/ha should be given alongwith irrigation water at 70-75 days after transplanting.
REFERENCES
REFERENCES


REFERENCES


Tripathi, S.N. and Bhattacharya, B. (1983). Effect of varying soil moisture and nitrogen levels on physical and chemical quality attributes of cigar wrapper tobacco. Indian Agric. 27 (3) : 207-214.


* Original not seen.
APPENDICES
**Appendix I: Cost of cultivation of common cultural operations carried out in rustica tobacco**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Cost Rs/ha 1993-94</th>
<th>Cost Rs/ha 1994-95</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A) Land preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Tractor cultivation (6 hr @ 96 Rs/hr)</td>
<td>576.00</td>
<td>576.00</td>
</tr>
<tr>
<td>2.</td>
<td>Harrowing and planking (2 PB, 2 HL)</td>
<td>340.00</td>
<td>340.00</td>
</tr>
<tr>
<td></td>
<td><strong>(B) Sowing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Opening furrow for fertilizer application and planking (2 PB, 2 HL)</td>
<td>340.00</td>
<td>340.00</td>
</tr>
<tr>
<td>2.</td>
<td>Cost of fertilizers</td>
<td>2301.00</td>
<td>2301.00</td>
</tr>
<tr>
<td>3.</td>
<td>Preparation of beds and irrigation chennals (1 PB, 6 HL)</td>
<td>270.00</td>
<td>270.00</td>
</tr>
<tr>
<td>4.</td>
<td>Cost of seedling (30,000 seedling/ha @ 30 Rs/ha)</td>
<td>900.00</td>
<td>900.00</td>
</tr>
<tr>
<td>5.</td>
<td>Transplanting (20 HL)</td>
<td>400.00</td>
<td>400.00</td>
</tr>
<tr>
<td>6.</td>
<td>Irrigation (2 common irrigations) (Cost of irrigation Rs.160.00, Application charges Rs. 40.00)</td>
<td>400.00</td>
<td>400.00</td>
</tr>
<tr>
<td></td>
<td><strong>(C) After care</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Gap filling (5 HL)</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>2.</td>
<td>Cost of seedling for gap filling (5000 seedling/ha @ 30 Rs/ha)</td>
<td>150.00</td>
<td>150.00</td>
</tr>
<tr>
<td>3.</td>
<td>Interculturing-2 times (3 PB, 6 HL)</td>
<td>570.00</td>
<td>570.00</td>
</tr>
<tr>
<td>4.</td>
<td>Weeding-4 times (48 HL)</td>
<td>960.00</td>
<td>960.00</td>
</tr>
<tr>
<td>5.</td>
<td>Topping and desuckering (45 HL)</td>
<td>900.00</td>
<td>900.00</td>
</tr>
<tr>
<td></td>
<td><strong>(D) Plant protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Cost of Monocil 500 ml Rs. 150.00 + Application charge (2 HL) Rs.40.00]</td>
<td>190.00</td>
<td>190.00</td>
</tr>
<tr>
<td></td>
<td><strong>(E) Harvesting (45 HL)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>(F) Preparation of produce for marketing (15 HL)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>(G) Land revenue</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total cost...** | **9637.00** | **9637.00**

PB = Pair of bullock @ Rs.150.00/pair  
HL = Human labour @ Rs. 20.00/day
APPENDIX-II : Analysis of variance for cured leaf yield

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>D.F</th>
<th>Mean sum of square</th>
<th>Cured leaf yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1993-94</td>
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* Significant at 5 % level
Appendix-III: Analysis of variance for plant height

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* Significant at 5% level
Appendix-IIIa: Pooled analysis of variance (1993-94 and 1994-95) for cured leaf yield and plant height

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* Significant at 5% level
### Appendix-IV : Analysis of variance for leaf length

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* Significant at 5 % level
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* Significant at 5% level
Appendix-Va: Pooled analysis of variance (1993-94 and 1994-95) for leaf length and leaf width

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* Significant at 5% level
Appendix-VI : Analysis of variance for growth score and spangle score

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* Significant at 5 % level
Appendix-VIa : Pooled analysis of variance (1993-94 and 1994-95) for growth score and spangle score

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* Significant at 5 % level
Appendix-VII: Analysis of variance for fresh weight of suckers and dry weight of weed

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* Significant at 5% level

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</tr>
<tr>
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<td>I x S x W</td>
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<td>1843.75</td>
</tr>
<tr>
<td>Y x I x S x W</td>
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<td>21.80</td>
</tr>
<tr>
<td>Pooled Error (B)</td>
<td>144</td>
<td>6558.19</td>
</tr>
</tbody>
</table>

* Significant at 5% level
Appendix-VIII: Analysis of variance for chemical parameters
(Total-N and Nicotine)

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>D.F.</th>
<th>Mean sum of square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Nitrogen (%)</td>
</tr>
<tr>
<td>Replication</td>
<td>3</td>
<td>0.02</td>
</tr>
<tr>
<td>Irrigation (I)</td>
<td>2</td>
<td>1.57*</td>
</tr>
<tr>
<td>Suckercide (S)</td>
<td>1</td>
<td>0.46*</td>
</tr>
<tr>
<td>I x S</td>
<td>2</td>
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</tr>
<tr>
<td>Error A</td>
<td>15</td>
<td>0.07</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td>4</td>
<td>0.09*</td>
</tr>
<tr>
<td>I x W</td>
<td>8</td>
<td>0.02</td>
</tr>
<tr>
<td>S x W</td>
<td>4</td>
<td>0.02</td>
</tr>
<tr>
<td>I x S x W</td>
<td>8</td>
<td>0.02</td>
</tr>
<tr>
<td>Error B</td>
<td>72</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* Significant at 5 % level
Appendix-VIIIa: Pooled analysis of variance (1993-94 and 1994-95) for chemical parameters (Total-N and Nicotine)

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>D.F.</th>
<th>Total N (%)</th>
<th>Nicotine (%)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.20</td>
</tr>
<tr>
<td>Year (Y)</td>
<td>1</td>
<td>18.24*</td>
<td>57.02*</td>
</tr>
<tr>
<td>Irrigation (I)</td>
<td>2</td>
<td>3.43*</td>
<td>12.56</td>
</tr>
<tr>
<td>Suckercide (S)</td>
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<td>1.03*</td>
<td>3.78*</td>
</tr>
<tr>
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<td>2</td>
<td>0.02</td>
<td>0.77</td>
</tr>
<tr>
<td>Y x S</td>
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<td>0.004</td>
<td>0.37</td>
</tr>
<tr>
<td>I x S</td>
<td>2</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Y x I x S</td>
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<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Pooled Error (A)</td>
<td>30</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td>4</td>
<td>0.11*</td>
<td>0.41*</td>
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<td>Y x W</td>
<td>4</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td>I x W</td>
<td>8</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>S x W</td>
<td>4</td>
<td>0.003</td>
<td>0.02</td>
</tr>
<tr>
<td>Y x I x W</td>
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<td>0.04</td>
<td>0.01</td>
</tr>
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<td>Y x S x W</td>
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<td>0.03</td>
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<tr>
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<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Y x I x S x W</td>
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<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Pooled Error (B)</td>
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<td>0.03</td>
<td>0.15</td>
</tr>
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</table>

* Significant at 5 % level
## Appendix-IX : Analysis of variance of orobanche weight (log transformation)

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>D.F.</th>
<th>Mean sum of square, Orobanche weight (kg/ha)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1993-94</td>
</tr>
<tr>
<td>Replication</td>
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</tr>
<tr>
<td>Irrigation (I)</td>
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</tr>
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<td>Suckercide(S)</td>
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<tr>
<td>I x S</td>
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</tr>
<tr>
<td>Error A</td>
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<td>0.33</td>
</tr>
<tr>
<td>Weedicide (W)</td>
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<td>0.09</td>
</tr>
<tr>
<td>I x W</td>
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<td>0.13</td>
</tr>
<tr>
<td>S x W</td>
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<td>0.02</td>
</tr>
<tr>
<td>I x S x W</td>
<td>8</td>
<td>0.04</td>
</tr>
<tr>
<td>Error B</td>
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<td>0.18</td>
</tr>
</tbody>
</table>

* Significant at 5 % level
Appendix IX a: Pooled analysis of variance (1993-94 and 1994-95) for orobanche weight (log transformation)

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>D.F.</th>
<th>Mean sum of 'square Orobanche weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
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</tr>
<tr>
<td>Year (Y)</td>
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</tr>
<tr>
<td>Irrigation (I)</td>
<td>2</td>
<td>2.75*</td>
</tr>
<tr>
<td>Suckercide (S)</td>
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<td>0.68</td>
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<tr>
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</tr>
<tr>
<td>Y x S</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td>I x S</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td>Y x I x S</td>
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<td>0.17</td>
</tr>
<tr>
<td>Pooled Error (A)</td>
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<td>0.18</td>
</tr>
<tr>
<td>Weedicide (W)</td>
<td>4</td>
<td>0.07</td>
</tr>
<tr>
<td>Y x W</td>
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<td>0.03</td>
</tr>
<tr>
<td>I x W</td>
<td>8</td>
<td>0.05</td>
</tr>
<tr>
<td>S x W</td>
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</tr>
<tr>
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<td>Y x S x W</td>
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<td>0.01</td>
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<tr>
<td>I x S x W</td>
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<td>0.03</td>
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<tr>
<td>Y x I x S x W</td>
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<td>0.02</td>
</tr>
<tr>
<td>Pooled Error (B)</td>
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<td>0.11</td>
</tr>
</tbody>
</table>

* Significant at 5 % level