Relative Efficacy of Varying Levels and Times of Application of Simazine and Atrazine on Growth and Yield of *Kharif* Maize (*Zea mays* Linn) Hybrid Deccan Double and Weed Flora

By

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B Sc (Agri) First Class with Hons

A Thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH

(AGRICULTURAL UNIVERSITY)

Rahuri, Dist Ahmednagar, (Maharashtra)

in partial fulfilment of the requirements for the degree of

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Approved by the Advisory Committee :

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CERTIFICATE

This is to certify that the thesis entitled "Relative efficacy of varying levels and times of application of simazine and atrazine on growth and yield of maize (Zea MAYS Linn.) hybrid Deccan Double and weed flora" submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth,Rahuri, District : Ahmednagar (Maharashtra) in partial fulfilment of the requirements for the degree of Master of Science(Agriculture) in Agronomy, embodies the results of a piece of bona fide research work carried out by Shri S.N. Jadhav under my guidance and supervision. It is of sufficiently high standard to warrent its submission to the Vidyapeeth (University) for the award of the said degree. No part of the thesis has been submitted for any other degree, diploma or publication in any other form.

The assistance and the help received during the course of this investigation and sources of literature referred to have been duly acknowledged.

(V.S. Khuspe)
Research Guide.

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Date : May 5, 1973.

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Jadhav

(S.N. Jadhav)

Rahuri,

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ABBRIVATIONS USED

S	-	Simazine
A	-	Atrazine
T_0	-	Pre emergence
T_1	-	Post emergence
T_2	-	Pre plus post emergence
a.i.	-	Active ingredient
a.e.	-	Acid equivalent
D_0	-	0.0 kg a.i. per hectare (Control)
D_1	-	1.0 kg a.i. per hectare
D_2	-	2.0 kg a.i. per hectare
D_3	-	3.0 kg a.i. per hectare
ha	-	hectare
cm	-	Centimetre/s
gm	-	Gramme
kg	-	Kilogramme
m	-	Metre/s
Wt	-	Weight
lb	-	Pounds
sq	-	Square
mm	-	Millimetre

INTRODUCTION

CHAPTER I

INTRODUCTION

Weeds pose a serious threat to successful crop husbandry. Maize is not an exception to this. Weeds emerge with emerging crop seed lings and if not controlled in the early stage of crop growth they may cause reduction in maize yield, depending upon the intensity and species of weeds present in an area. Agronomists, physiologists, biologists and farmers have been fighting against the weed menace from times immemorial. Since after the Second World War, introduction of chemicals in U.K. and U.S.A. from 1942 to 1944 has marked the real beginning of "chemical era in the weed control". In the course of the investigations of use of chemicals for controlling weeds, chlorobenzoic acids (Amiben), s-triazines (simazine, atrazine, pemetryne, ametryne) triazoles and other heterocylic derivatives were discovered for controlling weeds. The two important members of s-triazine group are simazine (2-chloro-4, 6-bis-ethylamino-s-triazine) and atrazine (2-chloro, 4-ethylamino-1,6-isopropyl-amino-s triazine) developed by J.R. Geigy; S.A. Basle; Switzerland. Research work conducted in Western countries have shown that they control a wide spectrum of both broad leaved weeds and grasses in variety of crops under a variety of climatic conditions with appropriate usage. The use of s-triazine compounds is safe as they have less residual effect and promise to open a new

prospect in chemical weed control. Studies done on these herbicides in western countries have shown that from s-triazine group simazine and atrazine are very effective for weed control in maize. They can be applied throughout the life period of maize plant for the control of grasses and broad leaved weeds. However, due to difficulties of application, these herbicides need to be applied before maize plant attains about 75 mm height. After this time high clearence sprayers are needed. However, the results of research obtained in western countries can not be directly applied under our conditions, since climate, soil management and weed species in maize culture vary markedly in India from those in foreign countries. Therefore, it is necessary to have systematic research on simazine and atrazine two members of s-triazine group having herbicidal properties, regarding doses, their times of applications and their inter-relationships under Maharashtra conditions.

Maize (Zea mays Linn.) is an important staple food crop of India and is now only next to the rice, Jowar, Wheat and Bajra. In India, it is grown over an area of 5.9 million hectares annually and the production is 5.7 million tonnes of grains. In Maharashtra, it is grown over an area of 1,77,000 hectares annually with production of 3.29 lakh tonnes. Besides, being used as a food, it has high industrial value for starch, is also suitable for multiple cropp-

ing programme and fodder purpose being of short duration. It has high yield potential per hectare per day as compared to other cereals. It is largely grown under rainfed conditions in Kharif season and is invaded by wide spectrum of grassy and broad leaved weeds inflicting heavy losses in yields. In Kharif season many a time, it becomes rather impossible to arrange timely weed control manually because of continuous rains. This results in luxuriant growth of weeds, which even if removed later, has already done permanent damage to the crop. A heavy loss in grain and fodder yield of maize due to weed competition has been estimated by some workers. (Nizamuddin and Rahman, 1960; Sharma et al. 1965, and Mani et al. 1967).

Any attempt to save the probable losses caused by weeds in maize would be of a great significance to the farmers of the country, in general, and Maharashtra maize growing farmers in particular. Atrazine and simazine have come to stay as standard herbicides for maize in most part of the world. Even in places where labour is in plenty these triazine compounds have proved better than hand weeding, since incessant rainfall many a time makes the latter inoperative. In India, too these herbicides have been reported effective by some workers. Sporadic researches by Indian Scientists on triazines, particularly simazine and atrazine have been recommended for controlling of weeds in maize. (Sharma

et al. 1965; Singh et al. 1969). These herbicides persist in the soil for a considerable duration, resulting in efficient weed control throughout the crop season, but their optimum dose varies according to plant, soil and climatic conditions. The use of the same recommended dose, irrespective of soil type, may be injurious to a particular crop and may leave also residues to harm the succeeding crop. Hence systematic research on these aspects need to be done.

With these considerations and background in view, the present investigation were planned, to find out an effective optimum dose and proper time of application of simazine and atrazine for weed control in maize (Zea mays Linn.) hybrid Deccan Double during the kharif season of 1972 at the Agronomy Farm, College of Agriculture, Poona.

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CHAPTER II

REVIEW OF LITERATURE

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CHAPTER II

REVIEW OF LITERATURE

The herbicides have been developed steadily since around 1900. However, the discovery of phenoxy acetic herbicides 2, 4-D and MCPA in Britain and United States from 1942 to 1944 marked the real beginning of "Chemical era in weed control". Under Indian conditions after the Second World War, the chemicals have been used for the control of weeds. The year 1950 witnessed the development of the three chemicals phenoxyethyl sulphate, phenoxy-propionic and phenoxybutyric acids. Whereas during 1956 the S-triazine compounds were formulated for chemical weed control. Recently the use of triazine compounds for weed control has been started in India. However, the research on these herbicides in maize under Indian conditions is limited although lot of work has been done in western world conditions. Literature available on the use of these herbicides in maize and classical research work on cereals, in general, and maize in particular has been reviewed in this chapter.

1. <u>Chemical control of weeds</u> :

triazine) are the most important phytotoxic compounds used for weed control.

The S-triazines herbicides are simple heterocyclic compounds. Chemically triazine herbicides are based on a ring of three carbon and three nitrogen atoms with three attached chlorine atoms, produced by the trimarization of cynogen chloride (CNCL). Among S-triazines, simazine and atrizine have high biological activity but they differ in biological activity from each other due to covalent bond reaction. Simazine and atrazine are non-toxic to human beings and animals when used in moderate doses, non-inflamable, non-irritating and non-corressive. Therefore, their use has plenty of scope as herbicides in maize and some other crops.

2. Phyto-toxicity of simazine and atrazine :

Available experimental evidence provide an ample proof of phyto-toxicity of S-triazines in varying degree in different crops.

Geigy (1957) reported some interesting differences in the tolerance of different species of crops to simazine . Simazine was tolerated by corn while, it was very toxic to some other crops at 2.5 to 10 kg a.i. of simazine per hectare, such as cotton and soybean. He also reported that grasses were somewhat more tolerant to simazine than some broad leaved weeds.

Ivens (1958) found that under East African conditions,

simazine killed a wide range of weed species without causing damage to maize.

Kmusli (1958) stated that corn was protected by possessing an enzyme system capable of detoxifying simazine and related compounds.

Roth (1958) had shown that corn rapidly breaks down simazine into non-toxic compounds whereas plants such as wheat and oat do not break it down, so they are susceptible to simazine. In another experiment, Roth (1958) added simazine to freshly pressed juice of corn and freshly pressed juice of wheat. After 100 hours he found that only 1-2 per cent of simazine in corn juice and about ninety per cent in wheat juice.

Schneider (1959) reported that root was much less susceptible to triazine injury than leaf so than triazines are readily absorbed by roots.

Moreland and Hill (1959) found that simazine reduced the photochemical activity (Hill reaction) of isolated barley chloroplast by 50 per cent at 4.6×10^{-6}m concentration.

Malnikov (1959) found that resistance of corn to simazine was due to the specific enzyme in thecorn which rapidly hydrolyses simazine, detaching its chlorine atom.

Davis, Funderberk and Sansing (1959) reported that simazine was very toxic to cucumber, intermediate to cotton and very little harmful to corn. The pattern of distribution

of simazine in different plant parts, differed with crops.

Craft (1959) had studied that the distribution of simazine in leaves and in potato tuber tissues and concluded that this compound upon entering the mesophyll, diffused along the cell wall and did not enter the living symplast.

Sexsmith (1960) observed that sweet corn when treated with atrazine at 2.5 kg a.i. per hectare caused no visible injury upto the time of tasselling.

Montgomery and Vergil (1961) reported that simazine and atrazine were metabolised in corn. The evidence for metabolism was confirmed by means of ion exchange and paper chromatography. It was shown that only trace amounts, if any, of this herbicide remained unchanged in the plant.This information, confirmed with the demonstration that the corn plant is able to degrade these triazines to $C^{14}O_2$ leads to the conclusion that corn plant rapidly metabolizes that compound.

Zweig and Ashton (1961) reported that atrazine treatments greatly modifies the course of organic synthesis in bean leaves.

Donnalley and Rahn (1961) concluded that following soil application, radioactive atrazine was readily translocated throughout 52.5 and 30 cm high maize plants. But it did not enter the ungerminated nut grass and potato tubers. However, ungerminated maize seeds absorbed atrazine.

Ragals and McCollum (1961) found the important role of micro-organism in the decomposition of simazine in the soil.

Burschel (1961) observed that the decomposition of simazine in soil occurs as a first order interaction. This indicates that under comparable conditions the same percentage of the original concentration will be found in the soil at given time, regardless whether the concentration was higher or lower one. The decomposition is highly dependent on the temperature and humus content of the soil. Increase in the proportion of humus means increase in the intensity of process. In heavy soils, simazine remains in upper 0.4 cm of soil even after considerable precipitation. If sand proportion is more herbicide may get into deeper zones.

Burnside Schmidt and Behrens (1961) reported that high temperature (100°C - 120°C) and to a lesser extent pH (pH_4) caused a significant deactivation of simazine in the soil. Further they studied phytotoxicity of simazine on young plants of oat, soybeans and corn as pre-emergence herbicide as it enters through the roots. They observed that except maize the other two crops were damaged to a certain extent.

Hamilton - Yuse (1962) observed that simazine was converted to slightly toxic product by 2-exy-4, 6-bis-ethyl-amino-S-triazine.

Hamilton and Moreland (1962) had isolated hydroxy simazine from simazine treated corn seedlings by solvent extraction and an indentification was made by Co-chromatography in given solvent system. The cyclic hydroxamate and its 2-glucoside was also isolated from corn seedlings. Both of the compounds split chlorine from simazine in vitro.

Wills and Davis (1962) found that in light atrazine significantly reduced water losses in plants and excised shoot of maize but caused no significant reduction of transpiration in darkness even with addition of heat to the leaves.

Palmer and Allen (1962) concluded that the greatest stimulation of oxygen uptake occurred with low rates of simazine and also found that simazine has a tendency to stimulate the respiration in roots.

Gast (1963) reported that herbicidal action in the soil is influenced by several factors such as absorption, leaching, chemical degradation, microbiological break down, absorption by higher plants, irradiation and evaporation.

Rodgers and Wilcox (1964) concluded that 2.5 kg a.e. per hectare of atrazine treatment was enough to cause phototoxicity at higher rates of water application at all depths. Simazine, too, was leached in lethal concentration sufficient to cause reduction down to a depth of at least 30 cm. At the lower rates of water application, each chemical was leached in toxic concentration to 5 to 10 cm depth less

than that it caused after applying at thehigher rates.

Klyueva (1964) studied the effect of application of simazine and atrazine on maize crop and found no toxic effect of low rates of atrazine on the succeeding crops. While with equivalent rates of simazine caused injury to all crops.

Comes and Timmons (1965) concluded that toxicity due to simazine and atrazine was severe to oats when exposed to sun-light on soil surface for 25 days. It later decreased when surface soil temperature did not exceed 49°C.

Fison Overseas Ltd. (1966) observed that perennial weeds (particularly tropical perennial weeds) withstand high dose of simazine 50 and will not be controlled by the over doses recommended for selective use of crops.

Harris (1966) studied the phyto-toxicity and the movement of herbicides. Simazine and atrazine were universely proportional to the extent of absorption. The initial phyto-toxicities of the herbicides tried in four soils was reflected in the concentrations required to reduce the fresh weight of oat by 50 per cent (ED 50 values) of the triazines, atrazine had the lowest ED 50 value.

Comstock and Andersen (1968) concluded from the work in progress regarding the inheritance of high tolerance to atrazine in flax (Linum usitatissimum) that hereditability

of atrazine tolerance in F_3 and other back crosses populationstudied, was relatively low, suggesting that selection for atrazine tolerance in flax population may be difficult.

Singh and Frazier (1969) reported that corn can apparently tolerate a high concentration of simazine because it can degrade it to Co_2. Wheat and sunflower although physiologically capable of completely degrading the simazine do so less rapidly than corn. Further they had stated that presence of chlorine atom in simazine molecule was found to be crucial for development of toxicity in plants. Replacement of chlorine atom by the hydroxyl group prevented toxicity development.

3. Effect of simazine and atrazine on growth and yield of maize :

Simazine and atrazine assuch are harmful to many plants, but their use as a herbicide in maize is due to the possession of a special mechanism in maize, which converts them to the non-toxic hydroxy simazine / atrazine. Due to effective weed control with simazine and atrazine the growth andyield of maize is favourably influenced.

Indyk (1959) stated that simazine at 5 kg a.i. per hectare showed slightly stunting of maize seedlings in early stage of crop growth. Tasselling and silking were retarded.

Vorobev and Cha (1960) reported that simazine did not increase the total nitrogen content in plant.

Nell (1961) observed in trials in which granular simazine at 5 kg a.i. per hectare was used and atrazine at 3.5 kg a.i. per hectare as pre-emergence gave significantly higher yield of maize than unweeded control.

Menezes (1961) stated that atrazine at 2-3 kg a.i. per hectare had given effective weed control, better growth and increased yield of maize.

Fleischer (1962) found that simazine at 4 kg a.i.per hectare and atrazine at 2 kg a.i. per hectare both in 800 litres water applied as pre-emergence spray 3 days after sowing, gave good weed control and at harvest resulted in 392 and 415 per cent increase in fresh weight, 382 and 421 per cent increase in dry matter content and 1.7 and 13.4 per cent decrease in number of plants per unit area respectively. Best results were obtained where atrazine at 2 kg a.i. per hectare in 800 litres of water was applied as pre-emergence spray 3 days after sowing. The results obtained at harvest were - 416 per cent increase in fresh weight, 439 per cent increase in dry matter weight and 4 per cent decrease in number of plants per unit area.

Schoene and Hagenloch (1962) reported in trials with W 6658 (simazine formulation unspecified) at 4 kg a.i. per hectare applied as pre-emergence that the dry matter yield of maize was increased by 19-59 per cent as compared with untreated uncultivated plots. Yields of dry matter on plots

cultivated and harrowed twice were increased by 31-62 per cent by a pre-emergence treatment of W 6658 at 4 kg a.i.per hectare. In plots which were harrowed twice and cultivated 1-3 times yields of dry matter were increased in all cases by pre-emergence treatment of W 6658 at 4 kg a.i. per hectare and atrazine at 2 kg a.i. per hectare. Atrazine gave slightly better results than W 6658 and increased yield by 77 per cent compared with 65 per cent with W 6658. Yields of cereals and potatoes following maize treated with W 6658 (simazine) and atrazine were not significantly affected.

Vorob'ev and Ch'a (1962) reported that when maize pea and Rumex sp. were analysed for their content of different types of N and amino acid content after treatment with simazine and 2, 4-D, in maize 2, 4-D lowered the protein content slightly andincreased the NH_3 and amino acid content considerably. Treatment with simazine did not increase the total N content of maize.

Menezes (1962) found that atrazine at 2-3 kg a.i.per hectare had given good weed control, better maize growth, and increased yields. French beans are very susceptible and can not be intersown. There were no harmful residual effect on Lolium perenne sown 4 months after the treatment or on wheat sown seven months after.

Austenson (1963) reported that simazine and atrazine each at 2 and 4 kg a.i. per hectare and Dinoseb amine at

4.5 kg a.i. per hectare when applied to maize grown for silage were found to be very effective.

Kuthe and Krantz (1963) concluded that simazine and atrazine at 1.6 kg a.i. per hectare gave good results when applied to maize as post-emergence upto 3 leaf stage, but reduced yields when applied at later growth stage.

Schoene (1963) conducted trials with simazine in 1958 and with atrazine in 1961 both herbicides applied as pre-emergence at the manufacturer's recommended rate in 600-800 litres water. It gave increased yield of maize grown for silage by 40 per cent in dry matter (green material only), 38 per cent in total dry matter and 20 per cent in cobs. Hoeing the plots after treatment did not improve the results obtained with simazine in 1959 and adversely affected those obtained with atrazine in 1961. Of the 31 weed species present, 28 were completely killed and 3 severely damaged by both treatments.

Lorenzoni (1963) concluded that weak solution of simazine accelerated the germination of maize seedlings. Maximum growth stimulation of seedling after application of 0.25, 0.5, 1.0, 2.0 and 4 mg per dmq was induced by 2 mg per dmq. After application of 0.25 - 2 mg per dmq the dry weight of maize seedling 30 days after germination increased progressively with every increase in dose. It was due to the growth stimulation involved in the whole of the plant by way of cell extension.

Verma and Bharadwaj (1963) reported that simazine was very effective weedicide for control of weeds in maize. Simazine applied as pre-emergence at 2.5 kg a.i. per hectare followed by 2 4-D at post-emergence stage controlled weeds and increased yield to almost the same extent as four hand weedings. Though the four hand weedings gave the best weed control and consequently the highest yields, the net profit under this treatment was 50 per cent lower than that with the application of simazine plus 2, 4-D because of the high labour cost involved.

Brassesco (1964) reported that simazine applied as pre-emergence at 2.25 kg a.i. in 600 litres spray / hectare immediately after sowing hybrids of maize, in clay soil, with 3 per cent organic matter content, gave total kill of weeds and yields exceeding those in cultivated control plots. Pre-emergence with atrazine at 1 kg a.i. per hectare or post-emergence in maize, when it was 30-40 cms high gave yields equal to cultivated controls and a rate of 2.5 kg a.i. per hectare increased these by a further 8 quintals. In each case flint responded better to atrazine than did bent varieties. Trietazine at 6 kg a.i.and ipazine at 12.1 kg a.i. per hectare gave yields superior to untreated controls, when used to treat maize as pre-emergence inspite of poorer control of weeds especially of grasses.

Alves and Forster (1964) reported that band spraying

of simazine (50 per cent) at 6 kg a.i. per hectare as pre-emergence application to maize in clay soil (terra rossa) resulted in higher yields than did similar treatment with 50 per cent atrazine, but the opposite occurred in a crop in sandy clay soil. Each crop was cultivated once only.

Damaskm (1965) observed that atrazine at 1.5 kg a.i. per hectare as pre or post-emergence application increased the yield of silage maize in clay loam soils by more than quarter, compared with hand weeded controls, and simazine increased it by more than one eighth. Both increased the protein content of maize stems and leaves compared with controls namely weeded and unweeded. Atrazine provided the best weed control.

Gyorffy (1965) reported that simazine and atrazine at 8 kg commercial products in 1000 litres spray / ha(less in light soils) with abundant rainfall and shallowly incorporated had given good results.

Ries and Gast (1965) concluded that low concentrations of simazine increased the content of nitrogen in maize plant regardless of nitrogen levels in growing medium. Atrazine also reduced nitrogen content of maize at high rates but increased the nitrogen content at low rates of application.

Singh and Singh (1966) tried simazine at different rates ranging from 3.5 to 7.0 kg a.i. per hectare as a

pre-emergence spray to maize. Simazine at 7.0 kg a.i.per hectare pushed up the fodder yield of maize to 74.34 q/ha.

Mani, Ranbhir Singh and Gautum (1966) reported that a pre-emergence blanket spray with either atrazine or simazine at 2 kg a.i. per hectare pushed the yield of maize to 51.0 q/ha.

Lozoratskaya (1967) reported that simazine and atrazine at 3 kg a.i. per hectare increased the fresh weight of maize by 8 and 0.5 per cent respectively. Cotton sown after harvesting the treated plots in the summer suffered slight reduction in yield.

Gupta and Rameshwar Singh (1967) indicated that uncontrolled weed crop competition reduced grain yield of corn by 31.8 to 49.7 per cent. These losses could be avoided by either hand weeding thrice or application of simazine at 1.12 kg a.i. in 900 litres of water per hectare.

An investigation was carried out in West Indies in 1967. Anonymous (1967) concluded that the yield of cobs with 1.25 kg a.i. atrazine per hectare in 20 litres of kerosene and 1.2 kg a.i. atrazine in 45 litres of kerosene was significantly higher (i.e. 106 and 102 respectively) as compared to promytrene, propazine and 2, 4-D which yielded 34, 55 and 33 per cent higher yield of cobs over the check respectively.

Buchholtz (1968) reported results of 8 years' trials at 5 locations in Wisconsin. He observed that the maize

yields were reduced by an average of 61 kg / ha for every 100 kg weeds (in term of dry matter) / ha present at harvest. Uncultivated plots treated immediately after sowing with atrazine at 0.89, 1.78 and 3.57 kg a.i. per hectare yielded the same as or more than the plots receiving the standard treatment of two cultivations. While the yield of atrazine treated plots was increased by 8 per cent by cultivation once when the crop was 50 cm high.

Trusova (1968) concluded that atrazine at 2 kg a.i. per hectare incorporated before sowing gave an average increase of 50 per cent in the yield of grain maize (upto 30 tonnes per hectares) over a 3 year period. The best residual effect was reflected in increasing the yield of winter wheat.

Khan and Megh Singh (1968) observed that atrazine applied as a pre-emergence spray markedly increased the yield of maize as compared to the post-emergence application and significantly as compared to no weeding treatment. Application of atrazine at 1 kg a.i. per hectare proved to be less effective than 2 kg a.i. per hectare.

Roy and Sharma (1968) stated that tafazine 50 (simazine 50 per cent) at 2.25 to 9 kg of a.i. per hectare when applied as pre and post-emergence or split between pre and post-emergence application, the maximum yields were obtained with the minimum rate and the split application.

Bozic (1968) opined that simazine applied at 3 kg a.i. per hectare in maize grown without normal cultivation on a chernozem soil at Zemun (Yugoslavia) simazine stimulated crop growth and increased the yields of grain by 25 per cent and yield of stover by 16 per cent.

Saghir and Choudhary (1968) found that pre-emergence application of simazine or atrazine at 2.5 kg a.i. per hectare one day after sowing gave effective control of weeds with yields comparable to those of hand weeded controls. Post-emergence treatments made 5 weeks after sowing were less effective and did not increase yields significantly over those of the unweeded control plots. In general, simazine caused more injury in subsequent crops than did similar rates of atrazine.

Chaurasia and Sharma (1969) observed that yield attributes such as length and girth of cob, number of grains per cob and 1000 grain weight were significantly influenced by pre-emergence application of full dose irrespective of weedicides. However, simazine at 2.80 kg a.i. per hectare increased the grain and stover yield of maize substantially.

Singh, Moolani and Bebl (1969) concluded that pre-emergence application of simazine and atrazine at 2 kg a.i. perhectare stunted the plant height, delayed reproductive growth and lowered the final stand of maize crop. Pre-emergence application of either of simazine or atrazine at

1 kg a.i. per hectare gave the maximum increase in maize yield. Pre-emergence application of simazine at 2 kg a.i. per hectare produced the lowest yield. Pre-emergence treatments of simazine and atrazine at 1 kg a.i. per hectare also increased the nitrogen uptake of the crop plant over the control.

Pande, Singh and Mukhtar Singh (1969) were of the opinion that pre-emergence application of simazine in combination with post-emergence treatment was significantly effective in increasing the yield of dry matter of maize.

Cumberland and McSweeney (1970) reported that maize plots which received atrazine at 1 or 2 kg a.i. per hectare remained free from broad leaved weeds throughout the season and produced higher yields than those which received 2, 4-D amine at 1.0 kg or limuron at 2 kg a.i. per hectare.

Gupta and Dhupia (1970) showed that atrazine applied at 2.0 kg a.i. per hectare to maize left residues responsible for reducing markedly both grain and stover yields of wheat crop. At lower rate of 1.0 and 1.5 kg a.i. per hectare the residual effect was much less resulting in total maize plus wheat production at par. Band application of atrazine to maize proved better than its usual blanket application in respect of lowering toxic residues and significantly increasing the total maize and wheat

production of grain and stover. Pre-plant Pre-emergence and post-emergence had no pronounced differential effect in respect of either maize crop yield or the herbicide residues.

Singh, Moolani and Behl (1970) reported that simazine and atrazine at 1 kg a.i. per hectare as pre-emergence sprays produced maximum yields of maize on a sandy loam soil in kharif with less than 5 cm rainfall and increased N uptake of the crop. Residues did not affect the following crop of wheat adversely during rabi.

Tripathi, Moolani and Tomer (1970) found that pre-emergence application of 1 kg a.i. per hectare of atrazine gave the highest fodder yield, which was closely followed by 1 kg a.i. per hectare of simazine. The dose of 1.5 kg a.i. per hectare of both the weedicides reduced the fodder yield considerably.

Sinha and Sinha (1970) were of the opinion that the higher yield of maize and succeeding crop of wheat were obtained by applying high dose (90 kg per hectare) of nitrogen and weedicides namely either atrazine or simazine at 2 kg a.i. per hectare in maize crop. Combined economics of maize and wheat indicated that atrazine at 2 kg a.i. per hectare gave the maximum net profit of Rs. 1,272.30 followed by simazine at 2 kg a.i. per hectare giving a net profit of Rs. 1,181.22 over the control.

Soreha and Singh (1970) reported that weed control through simazine, atrazine and hand weeding when comapared with no weeding in maize decreased the grain yield of maize by 30, 34 and 13 per cent and bhusa yield by 22, 28 and 15 per cent respectively and the area affected adversely was increased by 26.7, 32.7 and 18.2 per cent respectively. The highest yield of grain (38.9 q/ha) and bhusa (60.59 per hectare) and the lowest are (18.4 per cent) affected were obtained when the herbicides were applied at the rate of 0.5 kg a.i. per hectare and these were significantly superior to those obtained with the application of 4.0 kg a.i. per hectare respectively, thereby increasing the grain yield of wheat by 41 per cent, bhusa yield by 32 per cent and decreased the area affected by 64 per cent.

Sinha and Sinha (1970) reported that plant population of maize was significantly the highest at lower dose of weedicides i.e. simazine and atrazine at 1. kg a.i. per hectare than at higher dose of 2 kg a.i. per hectare. This may be due to injurious action of the weedicides. The lesser plant population in hand weeded and the control plots may be due to the supression of weaker maize plants by weeds. Again less plant population in hand weeded plots than the control may be due to the damage that might have been caused during hand weeding.

Saghir (1970) concluded that pre-emergence application of atrazine and simazine at 2.5 kg a.i. per hectare significantly increased the fodder and grain yield of maize as compared to the unweeded control plots.

Chokhey Singh and Pathak (1971) recorded that two levels of simazine at 0.8 and 1.6 kg a.i. per hectare along with mechanical weeding significantly increased the fodder and grain yield of maize gave the maximum additional return of 68.5 and 93.7 q / ha dry matter respectively over the control.

Protsenko (1972) observed that application of 2-3 kg a.i. per hectare of simazine or atrazine to maize, decreased the weed incidence by 88-92 per cent and increased the grain yields by 19-32 per cent over the control.

Chaurasia and Sharma (1972) conducted an experiment where maize was given 2.8 kg a.i. of simazine, 1.68 kg of 2, 4-D Na or 1.93 l of 2, 4-D ester per hectare all applied pre-emergence, post-emergence or in two split doses pre and post-emergence, with or without a hand weeding during the vegetative growth period. Simazine applied pre-emergence gave effective control of weeds and resulted in the highest grain yield of 2.79 tonnes per hectare as compared with 1.61 and 2.21 tonnes per hectare in plots given other treatments and in unweeded control plots. Simazine increased yields by increasing cob length and girth, number of grains per cob and 1,000 grain weight.

Shmaina and Kiperman (1972) reported that application of 3 kg a.i. of simazine per hectare had little effect on the content of total, N, but increased the percentage of protein N in the total N.

Mikam (1972) conducted an experiment in Kharif 1971 at Poona Agricultural College (Maharashtra) where simazine and atrazine were applied as pre emergence, post and pre plus post emergence at the rate of 0.5, 1.5 and 2.5 kg a.i. per hectare. He found that of the two weedicides atrazine at the rate of 1.5 kg a.i. per hectare as a pre plus post emergence application was more effective from the weed control point of view, as well as for enhancing the growth and yield contributory characters and finally the yield of maize over the simazine and unweeded control.

4. Effect of simazine and atrazine on weeds :

Experimental evidences available uptill now show that pre-emergence treatment of simazine and atrazine proved to be most effective in controlling both broad leaved and grassy weeds as compared to post-emergence treatment.

360 litres of water spray one day after planting resulted in complete control of annual weeds and severe stunting of top and root growth of Agropyron repens and other perennial weeds.

Minshall (1958) concluded that good control of red rot pig weed Amaranthus retroflexus, foxtail and barn yard grass. Echinoclos crusgalli and crab grass could be controlled when very low rates of 0.25 to 2.00 kg a.i. per hectare of simazine and atrazine were applied. But Portulaca oleracese and Cyperus rotundus were not affected at applied rates of simazine and atrazine.

Indyk (1958) stated that simazine gave outstanding broad leaf and grass weed control throughout the growing season even at 2.5 kg a.i. per hectare. In moist season and dry season 2.5 kg a.i. per hectare of simazine was more effective than 5.00 kg a.i. per hectare dose. Effective

throughout the entire season could be obtained by formulation of atrazine and simazine at 2.5 kg a.i. per hectare.

Aschemon and Bondarenko (1960) stated that granular formulation of atrazine and simazine applied as pre-emergence in 35 cm band at an overall rate of 3.12 kg a.i.per hectare in maize gave 95 to 100 per cent control of Amaranthus retroflexus, Chenopodium album, Setaria viridis and Setaria lutescens in early July.

Sexsmith (1960) reported that aggood control of Amaranthus retroflexus, Setaria viridus and Chenopodium album with atrazine at 2.5 kg a.i. per hectare could be obtained. Atrazine at 2.5 kg a.i. per hectare gave 90 per cent control of Avena fatua.

Andersen (1961) reported that atrazine applied after weed emergence did not control annual grasses. Simazine controlled weeds throughout the growing season and gave a significant increase in maize yields. In dry conditions in 1958, simazine treated plots yielded significantly less than the control.

Grancin (1961) working in N. Italy in 1960 had sprayed maize fields for weed control, with solution of Gesaprim and Gesatop which contained 50 per cent atrazine and simazine respectively. Results confirmed those obtained in the previous year. The rate of application generally recommended was 4.00 kg of Gesaprim or of a mixture of Gesaprim plus

Gesatop ber ha. Both atrazine and simazine gave effective control of weeds in maize, but atrazine had a quicker action. Simazine on the other had was more effective than atrazine against Digitaria and Setaria species and Chanopodium album. Amaranthus and Panicum species were easily controlled by both preparations. The efficacy of these herbicides was influenced by the moisture content of the top layer of the soil. Gesaprim at 2.00 kg a.i. per hectare was found to be sufficient in soil with high moisture.

Springer (1961) stated that atrazine at2.00 to 4.00 kg a.i. per hectare gave excellent control of broad leaved weeds and grasses. Simazine at these rates gave good control of broad leaved weeds but not of grasses. Atrazine was more effective than simazine when moisture was limited.

Schneider (1961) observed that maize was equally tolerant to simazine and atrazine. Simazine was of little use as a post-emergence herbicide, but atrazine performed favourably if applied at 2.00 kg per hectare to weeds and grasses, when not more than 3 to 5 cm high. Atrazine was more effective than simazine in controlling velvet leaf (Abutilon theophrasti) weed. Simazine gave better control of barn yard grass (Echinochloa crusgalli), Panicum species and crab grass (Digitaria sanguinalis). The greater solubility of atrazine made it more effective than simazine under dry conditions.

rotundus and Phaseolus trilobus (65 per cent reduction) seemed to be most desirable.

Meade and Santelmann (1962) found that if simazine when applied at 1.25 to 3.70 kg a.e. and 3.75 - 7.50 kg a.i. per hectare as pre-emergence and post-emergence respectively gave good control of all types of weeds.

Andrews (1969) reported that pre-emergence application of atrazine at 2.00 kg a.i. per hectare controlled the weed stand in maize consisting mainly of Digitaria sp. throughout the growing season.

Gruzdev and Bezyglov (1963) observed that atrazine and simazine were highly effective against weeds in maize on Sod-podzol soils. To control annual and perennial weeds, pre-emergence treatment with simazine or atr zine at 2-3 kg a.i. per hectare at the 4 to 6 leaf stage was recommended. Also 2, 4-D at the 4 to 6 leaf stage was found to be effective.

In the Institute of Rijkslandbouwhogeschool Anonymous (1963) found that atrazine and simazine at 2.5 kg a.i. per hectare were successful against Agropyron repens if applied shortly before sowing, after the deeper cultivations. In another trial, with maize sown on 10th May atrazine at 2.00 kg a.i. per hectare sprayed on the seedbed several days later gave very good control of Agropyron repens and annual broad-leaved weeds. When triazines applied at 2.00 kg a.i. per hectare 5 days after sowing were compared with calcium

cynamide at 200 and 400 kg per hectare, there was little difference in maize yield, in spite of the high N content of the last named, since calcium cynamide neither controlled A.repens nor Polygonum persicaria.

Anonymous (1964) reported that simazine at 2.5 kg a.i. per hectare supressed the sprouting of nut grass even six months after application.

Kosovac (1964) conducted a trial on maize using simazine as pre-emergence and atrazine as post-emergence spray. Results showed that optimum control of weeds was obtained only where treatments were used in conjunction with adequate inter-row cultivation and where an effective crop rotation was followed. Variations in soil temperature or moisture did not appear to affect the results.

Chapman (1965) observed that atrazine at 2 and 3 kg a.i. per hectare gave better pre-emergence control of weeds in maize than did simazine at similar rates.

Eddowes and Harpur (1965) conducted trials during 1959-62. Simazine and atrazine were applied as pre-emergence spray. Atrazine at 1.00 to 1.5 kg a.i. per hectare gave good control of annual weeds and was superior to simazine at equivalent rates. The performance of both herbicides was greatly influenced by the amount and season distribution of rainfall. In relatively dry conditions in 1961 atrazine at 1.00 kg a.i. per hectare was highly effective. Whereas simazine at this rate was only partly so.

At 0.5 kg a.i. per hectare neither compound was effective under dry conditions.

Rawson (1965) conducted trials in the Kingaroy District (Queensland) with 2, 4-D amine at 4.00 kg per hectare and atrazine at 2.00 kg a.i. per hectare. A good control of weeds was achieved when they were used as pre-emergence treatments in maize.

Sivaji and Rao (1965) carried out trials in 1962 on a sandy loam soil. Simazine with 50 per cent W.P. and atrazine with 80 per cent W.P. at 2, 4, 6 and 8.00 kg per hectare (of commercial product) were applied 2 days after sowing of hybrid maize. Weeds present included Amaranthus sp., Abutilon indicum., Euphorbia sp., Leucharas pusilla; Desmodium diffusum, Indigofera sp.; Phyllanthus sp., Cyperus rotundus, Cynodon dactylon and Panicum sp. Atrazine at 4.00 to 8.00 kg (commercial product) per hectare and simazine at 6.00 to 8.00 kg (commercial product) per hectare controlled bread leaf weeds and grasses. While 2 kg (commercial product) per hectare of either compound was sufficient to control the bread leaf weeds.

Alley and Chamberlain (1966) concluded in pre-emergence trial in maize that atrazine at 1.00 and 2.00 kg a.i. per hectare gave complete control of weeds at 2 locations (on sandy loam and clay loam soil). Various rates and ratios of chloramben atrazine provided 80-95 per cent control of

weeds. Where atrazine was applied as post-emergence treatment when weeds were 2.5 cm high 0.5 kg a.i. per hectare appeared almost as effective as rates two to four times as much.

Sharma et al. (1966) conducted an experiment at New Delhi. Maize was treated with simazine as pre-emergence spray at 2.24, 3.36, 4.48, 5.6 kg a.i. per hectare.At the lowest rate simazine controlled annual weeds without adversely affecting maize, but higher rates reduced the crop yield. On plot treated with simazine at the lowest rate, and hoed once, thirty days after sowing, all weeds were controlled and the yield of maize was as good as that obtained on hand weeded control plots

Paster (1966) reported that spraying with atrazine at 3.00 kg Dikonirt at 2.00 kg a.i. per hectare as post-emergence treatment increased the maize yields by 17-24 per cent compared to weed control by hoeing.

Chikulaev (1967) found that when simazine and atrazine were applied at 2.00 to 6.00 kg a.i. per hectare as pre-sowing and pre-emergence, the weed flora composed of predominantly of annual species of which 63-64 per cent were grasses were controlled satisfactorily. Simazine and atrazine at 3.00 kg a.i. per hectare before sowing gave virtually weed free condition throughout the season. The most susceptible weeds were Chenopodium album, Amaranthus retroflexus and Stachys annua.

Kim and Deordiev (1967) had carried out experiment during 1960-65 on a medium loamy residually weakly saline Chernozem soil. Simazine and atrazine a t 3.00 kg a.i.per hectare were applied before seed bed preparation. The herbicides showed, on an average, 90 per cent control of weeds. Simazine and atrazine increased maize grain yield on an average by 24 per cent over the control.

Lucas and Rousse (1968) observed that atrazine at 1.5 kg a.i. per hectare plus simazine at 1.5 kg a.i. per hectare as pre-emergence application led to no improvement in weed control compared with application of atrazine and simazine as pre-emergence alone.

Vanchikov (1968) recorded that the Bulgarian herbicides Kherbazin 50 (simazine 50 per cent) and Tsezazine (atrazine 50 per cent) at 3.00 to 4.00 kg products per hectare were effective against broad-leaved weeds in maize on a sandy clay soil of low organic matter.

Palatinus (1968) reported that zeazine (atrazine 50 per cent) at 2.00 to 5.00 kg (product per hectate) days after sowing maize in 1963 and at 2.00 to 8.00 kg per hectare 3 days before sowing maize in 1964 were effective in the control of weeds. A rate of 200 kg per hectare killed annual broad-leaved weeds. Generally 2.00 to 3.00 kg per hectare gave satisfactory overall weed control. Irrigation accelerated atrazine decomposition and reduced dangers from residues.

Menezes (1968) had tried simazin 50 (simazine 50 per cent) at 4.00, 3.00 and 2.00 kg a.i. per hectare applied as pre-emergence in hybrid maize on sandy soil of pH .5-4 Predominant weeds were Digitaria sanguinalis; D. horizontalis; E. fuscescens; Trichachne insularis; Rhynchelitrum repens; Cenchrus echinatus; Setaria geniculata; Cyperus rotundus and Acanthospermum australe. Simazine only delayed weed appearance for 20 days. There was no toxicity to maize and yields of treated plots were higher than those of untreated plots but the differences were not significant.

Tripath, Moolani and Tomer (1969) reported that application of simazine and atrazine at 1.0 and 1.5 kg a.i. per hectare respectively controlled weeds significantly over other treatments as evidenced by low infestation and lesser dry weight of weeds per unit area. Broad leaved weeds were controlled even at 0.5 kg a.i. per hectare. While Cyperus rotundus was not killed even at 1.5 kg a.i. dose of herbicede. However, its growth was considerably retarted.

Bokde (1970) concluded that atrazine at 2.5 kg a.i. per hectare as pre-emergence and 2.00 kg a.i. per hectare as post-emergence, controlled broad leaved weeds, but not grasses in maize trials during 1964-67.

Krishnamurthy et al. (1970) made studies on the control of weeds in hybrid maize (Ranjit and Deccan)with the use of herbicides (simazine, atrazine, 2, 4-D and

Paraquat) at varying levels (1.25 to 2.5 kg per litre/ha) and as pre-emergence and post-emergence applications in the Thungabhadra Project area as well as at Bangalore, under irrigated conditions and normal cropping conditions.Simazine or atrazine at 2.5 kg a.i. per hectare as pre-emergence application and if needed coupled with a post-emergence application of 2, 4-D at 1.25 kg a.e. per hectare appeared to be an economical and effective weed control schedule.

Verma., Bhardwaj and Choudhary (1970) reported that good control of weeds could be achieved with pre-emergence application of simazine. Atrazine another triazine compound, had proved to be more effective than simazine especially when used under dry conditions or when weeds had germinated.

Singh and Singh (1970) reported that simazine at 1.00 to 4.00 kg a.i. per hectare as pre-emergence in maize was found to be effective in controlling all types of annual weeds including grasses.

Singh and Rao (1971) concluded that best weed control could be obtained by spraying simazine (Tafazine 50) at 3.4-4.5 kg.a.i. per hectare dissolved in 454 litres of water one day after sowing maize.

Chaldhay Singh and Pathak (1971) conducted experiment at research farm, Jhabua and reported that two levels of simazine, that is, 0.8 and 1.6 kg a.i. per hectare controlled both dicot and monocot weeds. Per cent kill of weeds was

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CHAPTER III

MATERIALS AND METHODS

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CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials used and methods adopted in the conduct of the present investigation.

1. Experimental site :

A field experiment was laid out in kharif season of 1972 on the plot numbers 522, 523 and 524 in the 'D' division of the Agronomy Farm of the College of Agriculture, Poona-5.

1:2. Soils :

The field selected for the experiment was uniform in soil depth and levelled. Soil was medium black calcareous type, 2 metres in depth with good water holding capacity. Seventy two soil samples from 0 to 22 cm depth were taken by selecting the spots at random extending over the experimental area and mixed thoroughly to obtain representative soil sample. It was analysed to study the initial physical and chemical properties and fertility status of the soil. The results obtained are presented in Table 1.

1:3. Climatic conditions :

Poona comes under the transitional belt. Geographically, it is situated at the elevation of 538.5 metres above the mean sea level on the 18° 32' North Latitude and on the 73° 51' East Longitude.

The mean annual precipitation is 675 mm received in

Table 1 : Mechanical and chemical composition of the surface soil from the experimental plots (0 - 22 cm depth).

Characteristics	Particulars	
A-Mechanical constituents		
1. Coarse sand	Per cent	6.95
2. Fine sand	Per cent	19.32
3.Silt	Per cent	11.80
4. Clay	Per cent	48.97
Textural class		Clayey
B-Chemical constituents		
1. Total nitrogen	Per cent	0.094
2. Available P_2O_5	Per cent	0.0028
3.Available potash (K_2O)	Per cent	0.078
4. Organic carbon	Per cent	0.660
5. Organic matter	Per cent	0.95
6. $CaCO_3$	Per cent	8.02
C : N ratio		7.02
C-Other details		
1. Maximum water holding capacity	Per cent	60.10
2. pH		7.9

45 rainy days. Out of this total precipitation 75 per cent is received during the months of June, July, August and September from South-West Monsoon and is helpful to Kharif crops. While the remaining is received from South-East Monsoon mainly in the months of October and November.

The temperature is very high in the months of April and May. The mean maximum temperature ranges from 37°C to 38°C in the summer. May is the hottest month. With the commencement of Monsoon, the mean maximum temperature lowers down to about 28°C in the months of June-July and ranges between 26°C and 28.6°C. The temperature again gradually increases in the months of September and October, till the winter season sets in. From November onwards, the ragnge between maximum and minimum temperatures goes on widening. In winter, from November to the middle of February, the minimum temperature is about 11.6°C. December is the coldest month during which time the temperature ranges between 4.8°C and 12.9°C. The mean humidity during kharif season, from June to September ranges from 78 to 95 in the morning while it is between 51 and 81 per cent in the evening.

The relevant meteorological observations during the crop period of the present investigation in kharif 1972, obtained from the Agricultural Meteorological Observatory situated at the Agricultural College Farm, Poona-5 are presented in Table 2.

Table 2 : Meteorological data recorded during the cropping period in Kharif 1972.

Meteorological week	Dates	Mean temperature °C Maximum	Mean temperature °C Minimum	Mean relative humidity per cent Morning	Mean relative humidity per cent Evening	Rainfall in mm	No.of rainy days
1	2	3	4	5	6	7	8
			June, 1972				
23	4-10	36.0	23.3	78	32	-	
24	11-17	35.9	23.9	80	34	0.6	1
25	18-24	33.5	23.6	88	47	6.1	3
26	25-1	28.6	22.1	97	63	31.2	7
			July, 1972				
27	2-8	27.2	22.2	98	77	112.7	7
28	9-15	27.8	23.4	97	60	32.0	5
29	16-22	29.3	22.0	91	56	0.6	2
30	23-29	28.9	22.2	91	57	6.3	4
31	30-5	28.9	21.9	95	57	1.8	2
			August, 1972				
32	6-12	28.1	21.4	97	63	4.4	4
33	13-19	27.8	21.3	95	61	6.3	4
34	20-26	28.1	22.2	95	60	0.3	2
35	27-2	29.5	21.2	88	55	0.9	1
			September, 1972				
36	3-9	30.7	21.4	93	54	-	-
37	10-16	29.1	22.0	95	61	23.0	4
38	17-23	33.3	20.4	99	33	55.8	2
39	24-30	34.0	18.1	99	22	-	-
			October, 1972				
40	1-7	35.1	19.0	94	24	-	-
41	8-14	34.8	17.8	97	21	-	-
42	15-21	35.5	19.6	91	22	-	-
43	22-28	32.2	20.5	79	32	-	-
44	29-4	28.7	19.9	89	51	15.9	3
					Total :	297.9	51

From the data presented in Table 2, it would be observed that the rainfall at the commencement of Monsoon in July was sufficient for sowing maize. The sowing of maize was done on July 10, 1972. Because of sufficient rains received at sowing time, germination and initial growth of the crop was satisfactory.

But subsequently from the 2nd fortnight of July to middle of August, the rainfall was inadequate for maize crop and also for the weed flora. The requirement of moisture was made good by irrigation.

The temperatures prevailing during the sowing time and the crop growth period were favourable. The maximum and minium temperatures during the crop growth period were 35.5°C and 27.8°C respectively. The humidity was very high during the crop season. In general, temperatures and humidity were favourable for the growth of maize and weed flora except that rainfall after sowing was inadequate.

1:4. Cropping history of the experimental plots :

The history of cropping programme followed during previous three years on the experimental plot is prepared in Table 3. It is obident from Table 3 that previous rabi crop was wheat. The wheat maize rotation was not a desirable one but due to heavy fertilisation of both the dwarf types of crops, the fertility of plot seems to have not been influenced markedly.

Table 1 : Schedule of crops grown on the experimental plots during previous three years.

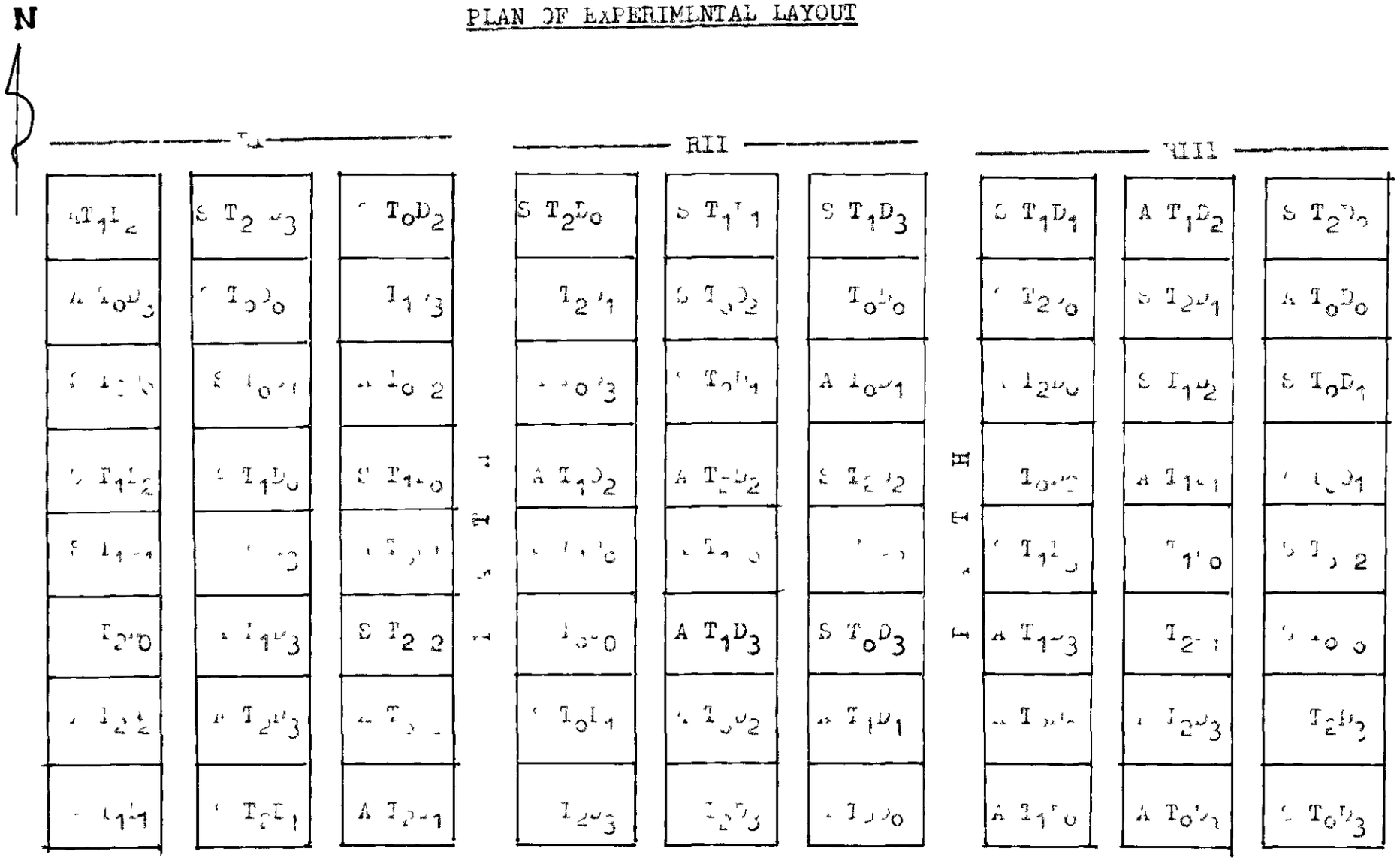
Sr. No.	Year	Season	Crop
1	1969-70	Kharif	Hybrid Jowar CSH-1
		Rabi	Fallow
2	1970-71	Kharif	Soybean
		Rabi	Wheat (Sonalyka)
3	1971-72	Kharif	Fallow
		Rabi	Wheat (Sonalyka)
4	1972-73	Kharif	Deccan Double Hybrid (Maize) of present investivation.

2. Experimental details :

The experiment was laid out in a factorial randomised block design. The experiment consisted of twenty four treatments, replicated three times. The factorial combinations of treatments were formulated by combining two types of weedicides namely simazine and atrazine, the four levels of each weedicide namely 0.0, 1.0, 2.0 and 3.0 kg a.i. per hectare and three times of application namely pre-emergence, post and pre plus post emergence. Thus in all there were 2^4 treatments. The detailed plan

FIG.1

PLAN OF EXPERIMENTAL LAYOUT



DESIGN : FACTORIAL RANDOMISED BLOCKS

GROSS PLOT SIZE : 7.50 × 4.80 sq m

NET PLOT SIZE : 6.00 × 3.60 sq m

of field layout is presented in Figure-1 and treatments details of the experiment along with symbols used are presented in Table 4.

3. Field operations :

The details of various cultural operations carried out during experimentation are presented in Table 5.

4. Seeds and sowing :

The certified seeds of the Deccan Double Hybrid maize was obtained from the National Seeds Corporation, Regional Office, Poona. Deccan Double Hybrid maize is recommended as high yielding hybrid by the Department of Agriculture, which matures within 100 to 105 days in Kharif season. Two seeds were dibbled per hill to a depth of 5 cm. At the time of sowing, soil moisture was adequate for germination of seeds. The spacing between two hills in a row was 30 cm and the spacing between the two rows was 75 cm. The seeds started germinating from the 4th day and it was complete by the 8th day.

5. Chemical control of weeds :

The herbicides namely simazine and atrazine were obtained from Rallies India Limited Bombay-1. At the time of spraying the herbicides, the quantity of water used was 1,000 litres per hectare for both pre-emergence and post-emergence sprays. The quantity of water applied as well as quantity of herbicides as per different doses per plot

Table 4 : Treatment details of field experiment along with symbols used.

	Details of treatments	Symbol
Pre-emergence application	0.0 kg a.i. per ha of simazine	S To Do
	1.0 Kg a.i.per ha of simazine	S To D1
	2.0 Kg a.i. per ha of simazine	S To D2
	3.0 Kg a.i. per ha of Simazine	S To D3
Post-emergence application	0.0 Kg a.i. per ha of simazine	S T1 Do
	1.0 Kg a.i. per ha of simazine	S T1 D1
	2.0 Kg a.i. per ha of simazine	S T1 D2
	3.0 Kg a.i. per ha of simazine	S T1 D3
Pre plus post emergence application	0.0 Kg a.i. per ha of simazine	S T2 Do
	1.0 Kg a.i. per ha of simazine	S T2 D1
	2.0 Kg a.i. per ha of simazine	S T2 D2
	3.0 Kg a.i. per ha of simazine	S T2 D3
Pre-emergence application	0.0 Kg a.i. per ha of atrazine	A To Do
	1.0 Kg a.i. perha of atrazine	A To D1
	2.0 Kg a.i. per ha of atrazine	A To D2
	3.0 Kg a.i. per ha of atrazine	A To D3
Post-emergence application	0.0 Kg a.i. per ha of atrazine	A T1 Do
	1.0 Kg a.i. per ha of atrazine	A T1 D1
	2.0 Kg a.i. per ha of atrazine	A T1 D2
	3.0 Kg a.i. per ha of atrazine	A T1 D3
Pre plus post emergence application	0.0 Kg a.i. per ha of atrazine	A T2 Do
	1.0 Kg a.i. per ha of atrazine	A T2 D1
	2.0 Kg a.i. per ha of atrazine	A T2 D2
	3.0 Kg a.i. per ha of atrazine	A T2 D3

Table 5 : Schedule of field operations done in the experimental plots.

Operations	Frequency of operations	Implement used	Date of operation
1	2	3	4
A) Preparatory Tillage			
Plowing	2	i) Tractor	15-4-72
		ii) Victory plough	22-4-72
Harrowing	2	Blade harrow	14-6-72
Collection of College of Stubbles.	1	-	26-6-72
B) Sowing			
Levelling	1	Maind	10-7-72
Marking and layout	1	Marker	10-7-72
Dibbling of seeds with hand	1	-	10-7-72
C) Spraying of herbicides	2	Murat sprayer	13-7-72 (Pre-emergence)
			3-8-72 (Post-emergence) spray
D) Gap filling	2	-	18-7-72
			25-7-72
E) Plant Protection measures			
Spraying of endrine 0.02 per cent	2	Power sprayer	25-7-72
			28-7-72

Table 7 (Continued)

1	2	3	4
Spraying of endrine 0.04 per cent	1	Power sprayer	30-8-72
Dusting of 10 per cent BHC	1	Duster cum Power sprayer	31-8-72
Application of endrine granules	1	-	13-8-72
F) Irrigations	2	-	13-8-72 25-8-72
G) Application of Fertilizers	2	-	
Basal dose of urea, single super phosphate and muriate of potash at the rate of (50 kg N, 50 kg P_2O_5 and 60 kg K_2O per hectare	-	-	10-7-72
Top dressing with 50 kg N	-	-	11-8-72
H) Harvesting and processing			
Picking of cobs	1	-	18-10-72
Harvesting of planks	1	Sickles	20-10-72
Drying of cobs	1	-	22-10-72 23-10-72 24-10-72
Shelling of cobs	1	Hand maize sheller	14-11-72 15-11-72 16-11-72 17-11-72

were fixed on an area basis. The spraying of pre-emergence dose was done after 3 days from planting (dibbling) of seeds. In case of pre plus post-emergence spray, half the quantity of herbicide was calculated on an area basis per plot. It was applied after sowing second half was applied twenty three days after sowing. After nine days of post-emergence spray, irrigation was given.

6. Fertilizer application :

The crop was fertilized with 100, 75 and 35 kg N, P_2O_5 and K_2O per hectare respectively. Half the quantity of nitrogen through urea, full dose of P_2O_5 and full dose of K_2O were applied before planting of maize as a basal dose. As a top dressing, half the dose of nitrogen i.e. 50 kg per hectare was applied, one month after planting. Nitrogen was supplied through urea analysing 44 per cent nitrogen. For supplying phosphorus and potash single superphosphate and muriate of potash analysing 16.0 per cent P_2O_5 and 58.0 per cent K_2O respectively were used.

Since a very small quantity of nitrogen is present in simazine and atrazine it was ignored in this experiment.

7. Observations :

To study the effect of various treatments on plant characters biometric observations were recorded at regular interval of fifteen days throughout the life period of the maize crop. The schedule of the biometric observations

followed for various characters of maize are presented in Table 6.

8:1. Sampling :

Five plants were selected randomly in each net plot for recording bio-metric observations. The selected plants were labelled and were marked by fixing pegs near them. All the observations namely height of plant, number of functional leaves, cobs and yield of grain per plant were recorded on these plants.

8:2. Plant Population :

8:2:1. Germination count :

All the germinated hills from net plots were observed and germination percentage was worked out on the theoretical basis.

8:2:2. Plant density at harvest :

After harvest of crop, the plant stand density was taken by counting the number of stalks per net plot.

8:3. Growth and developmental studies :

8:3:1. Height of plant :

Height of plant generally indicates the growth of a crop. Observations on plant height were recorded from the 30th day, at an interval of 15 days upto 90 days. It was measured from the ground level upto the base of the last fully opened leaf upto the tassel emergence and from the ground level to the base of tassel after tassel emergence.

Table 6 : Schedule of biometric observations adopted.

Characters observed	Frequency	No.of plants observed	Observations recorded -days after sowing.
1	2	3	4
A) Pre harvest studies			
1. Germination count	2	All plants in net plot	10 and 15
2. Height of plant (cm)	5	5	30, 45, 60, 75 and 90
3. Number of functional leaves per plant	5	5	30, 45, 60, 75 and 90.
4. Leaf area per plant (sq cm)	5	1	30, 45, 60, 75 and 90
5. Dry weight of aerial parts per plant (gm)	5	1	30, 45, 60, 75 and 90
6. Weed count	2	1 M^2 area	15 20 and 30
B) Post harvest studies			
1. No.of cobs per plant	1	5	At harvest
2. Length of cob(cm)	1	5	At harvest
3. No.of grain rows per cob	1	5	At harvest
4. No.of grains per cob	1	5	At harvest
5. Total weight of cob (gm)	1	5	At harvest
6. Weight of grains per cob (gm)	1	5	At harvest
7. Weight of husk per cob (gm)	1	5	At harvest
8. Dry weight of heart per cob (gm)	1	5	At harvest
9. Thousand grain weight (gm)	1	1	At harvest

Table 6 (Continued)

1	2	3	4
10. Dry weight of cob per net plot(kg)	1	All plants from net plot	At harvest
11. Yield of grains per net plot(kg)	1	All plants from net plot	At harvest
12. Dry weight of heart per net plot (kg)	1	All plants from net plot	At harvest
13. Dry weight of husk per net plot(kg)	1	All plants from net plot	At harvest
14. Grain to cob ratio	1	All plants from net plot	At harvest
15. Plant population per net plot	1	All plants from net plot	At harvest
C) Chemical studies :			
1. Soil samples for moisture percentage	1	-	At harvest
2. Analysis of plant parts for total nitrogen	1	1	At harvest
3. Analysis of grains for protein content	1	1	At harvest
4. Analysis of weed samples for N, P and K content	1	-	At harvest
5. Analysis of soil sample for mechanical analysis	1	-	Before planting
6. Soil analysis for -			
a) Total nitrogen	1	-	At Harvest
b) Available P_2O_5 and			
c) Available K_2O			

8:3:2. Number of functional leaves :

Number of functional leaves per plant gives an idea about the general vigour of a plant. The total number of functional leaves (fully opened) per plant was recorded, on the same dates on which observations on height were recorded.

8:3:3. Leaf area (LA) :

From the 30th day onwards, one plant from each net plot at random was removed for leaf area studies. All the leaves from the plant removed, were separated and grouped into three categories namely large, medium and small. Then one representative leaf from each category was taken at random and its maximum length and maximum breadth were recorded.Leaf area per plant then was calculated by using the formula :

LA = Maximum length x maximum breadth x 0.745.

The observation on theleaf area was recorded on the 30th day after planting and then at 15 days interval upto 90th days.

8:3:4. Leaf area index (LAI) :

LAI presents the ratio of theleaf area per plant to the land area provided for the plant expressed in the same units. The leaf area index was calculated by using the formula given by Watson (1952).

$$LAI = \frac{\text{Leaf area}}{\text{Land area}}$$

(expressed in the same units).

8:3:5. Total dry matter per plant :

The plant which was selected at random for leaf area observations from each treatment was used for dry matter studies

Each plant part namely stem, leaves, tassels, cob, grains etc. was separated as and when available. These separated parts were dried in the sun and afterwards in the thermostatically controlled oven at 60°C ± 2°C. After complete drying, the weight of each plant part was recorded separately and subsequently dry matter per plant was worked out.

8:4. Growth analysis :

In order to evaluate the effects of treatments on growth, studies on physiological growth functions namely Absolute Growth Rate (AGR), Relative Growth Rate (RGR) and Net Assimilation Rate (NAR), were made.

8:4:1. Absolute Growth Rate :

The mean rate of increase (AGR) in plant height and dry matter in grammes per week was calculated by the following formula :

$$AGR = \frac{(h2 - h1)}{(t2 - t1)} \quad \text{for height}$$

$$AGR = \frac{(W2 - W1)}{(t2 - t1)} \quad \text{for total dry matter.}$$

Where,

h2 and h1 and W2 and W1 refer to height and total dry matter per plant at times t2 and t1 respectively.

8:4:2. Relative Growth Rate :

Blackman (1919) considered an increase in the dry weight of a plant as a process of continuous compound interest, wherein an increment in any interval adds to the capital

the subsequent growth. This rate of increment is known as RGR and was worked out by using the following formula :

$$RGR = \frac{(\log_e W2 - \log_e W1)}{(t2 - t1)}$$

Where,

W2 and W1 represent total dry weight of a plant at times t2 and t1 respectively.

8:4:3. Net Assimilation Rate :

NAR represents the photosynthetic efficiency of leaves and is calculated by using the formula given by Gregory(1926).

$$NAR = \frac{(W2 - W1)(\log_e L2 - \log_e L1)}{(t2 - t1)(L2 - L1)}$$

Where,

W2 and W1 refer to the total dry matter per plant at times t2 and t1, when the corresponding leaf area would be L2 and L1 respectively.

9:3. Yield contributing characters :

9:3:1. Number of cobs per plant :

At the time of harvest, the number of cobs on each observation plant was counted and mean number of cobs per plant was worked out.

9:3:2. Length of cob :

The cobs from each observation plant were removed and the mean length of a cob was measured on the basis five observation plants per treatment. Length of cob was measured in cm from the base of the cob upto the tip of the cob.

9:3:3. Number of grain rows per cob :

The grain rows per cob from each observation plant were counted and mean per cob was worked out per treatment. It gives an idea about the relationship between grain rows and yield obtained in various treatments.

9:3:4. Total weight of cob with husk and without husk :

Total weight of cob with husk and without husk from each observation plant was recorded and then average was worked out. This gives an idea about the effect of various treatments on reproductive growth.

9:3:5. Number of grains per cob :

Total number of grains on the cobs from each observation plant was counted and then the average was worked out for each cob.

9:3:6. Total weight of grains per cob and per plant :

The cobs per observation plant was shelled by hand. The grains obtained were dried in the sun and air dry weight of grains per cob was recorded.

9:3:7. Weight of heart per cob :

The heart per cob on observation plants after shelling was dried and average was worked out for each cob.

9:4. Post harvest studies :

9:4:1. Thousand grain weight :

A random sample of thousand grains from the produce of each treatment plot was taken by quadrant method for recording thousand grain weight per treatment.

9:4:2. Dry weight of heart :

After shelling of dried cobs this observation was made, in order to study the effects of various treatments on the development of heart.

9:4:3. Yield of grains :

Total produce of cobs from each net plot was dried in the sun for 21 days and then husk was removed by hand. Average weight of husk per net plot was recorded. Shelling of dried cobs was done with the help of hand maize sheller. The husk, heart and grains were dried separately, in the sun. The final weight of grains was recorded after complete drying separately.

9:4:4. Weed Index (W.I.) :

Weed index is calculated by using the formula .

$$W.I. = \frac{(x - y) \times 100}{y}$$

Where,

x refers to the yield of clean plot and y for grain yield of weedicide applied plot.

9:4:5. Yield of fodder :

The harvested plants were sun dried, till they showed constant weight. The weight fodder per net plot was recorded.

9:4:6. Grain to cob ratio :

Grain to cob ratio was calculated by dividing the weight of grains by the weight of cobs per net plot.

10. Chemical studies :

10:1. Moisture percentage of the soil :

At harvest, soil samples from each treatment were taken for determination of moisture percentage from the soil surface down to 22 cm depth. It was determined gravimetrically. The soil moisture percentage was expressed on oven dry weight basis.

10:2. Plant analysis :

Plant parts obtained from the final observation recorded on the 90th day after planting, were used for chemical analysis. The oven dry plant parts samples were ground to fine powder (100 mesh) and were used for the determination of nitrogen. The leaves, stem and reproductive parts of each plant, per treatment, were analysed separately for nitrogen content.

10:3. Grain analysis :

The sample which was used for thousand grain weight was used for determination of nitrogen percentage in it.

10: 4. Protein content :

From this protein percentage in the grain was calculated by multiplying it with 6.25 as proteins contain 16 per cent nitrogen.

10:5. Soil analysis at harvest :

Immediately after harvest of maize crop, soil sample from each treatment plot was drawn to a depth of 22 cm and analysed for nitrogen, available P_2O_5 and K_2O.

11. Studies on weeds :

11.1. Studies on intensity of weeds :

Intensity of weeds occuring in the net plot was calculated by quantitative method. For this purpose, a quadrant having an area of one m^2 was thrown randomly in a net plot and the count of each species of weeds was taken. The first weed count was taken after pre-emergence and before post-emergence spray and second was taken 10 days after post-emergency spray.

11.2. Studies on the types of weed species :

At the times of taking the weed count, the number of each species of weed was recorded separately.

11.3. Dry weight of weeds :

After ninety days, all the weeds from each treatment plot were removed, air dried and their weights were recorded.

12. Chemical analysis of weeds :

Five composite samples of weeds drawn from available weeds and analysed for nitrogen by Kjeldahl's method (A.O.A.C. 1955) phosphorus by triacid extraction an t - tration method (Vanado molybdate method) and potash was determined by using flame photometer, (A.O.A.C. 1955). On the basis of dry weight of the weeds, the quantities of N, P and K per plant were estimated. Quantities of these nutrients removed by weeds were then worked out.

13. Economics of weedicides :

On the basis of results obtained from the field experiment, the economics of various treatments was worked out.

14. Statistical analysis and interpretation of the data :

The statistical analysis of the data was done by using the standard statistical method of analysis of variance (Fisher, 1935) and appropriate standard error (S.E.) for each factor was worked out. Whenever the results were found to be significant critical difference values (C.D.) at 5 per cent level of probability were worked out and are given wherever necessary. Graphical illustrations of the data have also been given at relevant places.

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CHAPTER IV

EXPERIMENTAL FINDINGS

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1. Germination percentage :

Data regarding the mean germination percentage per plot as affected by various treatments are presented in Table 7.

Data from Table 7 would reveal that the mean germination percentage of maize was 94.28.

Effect of weedicides :

The mean germination percentage was not affected significantly by the weedicides.

Effect of concentration-s :

The consentrations did not affect the mean germination percentage significantly.

Effect of times of application :

Times of application tried were found to be equivalent in effect.

Effect of interaction :

Interaction effects were found to be not significant.

2. Plant population :

Data pertaining to mean plant number in the net plot at harvest as affected by treatments are presented in Table 8.

Effect of weedicides :

Weedicides did not affect the mean plant number per net plot significantly.

Effect of concentrations :

Plant number per net plot was slightly higher with 1.0,

Table 7 : Mean germination percentage as affected by treatments.

Treatment	10 days after sowing
Weedicides	
S	93.27
A	95.30
'F' test	N.S.
S.E. ±	0.80
C.D. at 5 %	-
Concentrations	
D_0	94.16
D_1	94.50
D_2	93.61
D_3	94.88
'F' test	N.S.
S.E. ±	1.13
C.D. at 5 per cent	-
Times of application	
T_0	94.25
T_1	93.66
T_2	94.45
'F' test	N.S.
S.E. ±	0.99
C.D. at 5 per cent	-
Interactions	N.S.
General Mean	94.28

N.S. = Not significant.

Table 8 : Mean plant population per net plot as affected by treatments.

Treatments	Plant population at harvest
Weedicides	
S	167.02
A	171.25
'F' test	N.S.
S.E. ±	4.88
C.D. at 5 per cent	-
Concentrations	
D_0	165.77
D_1	170.27
D_2	170.38
D_3	169.22
'F' test	N.S.
S.E. ±	6.96
C.D. at 5 per cent	-
Times of application	
T_0	170.25
T_1	167.95
T_2	168.79
S.E. ±	168.79 N.S.
C.D. at 5 per cent	-
Interactions	N.S.
General Mean	169.13

N.S. = Not significant.

and 2.0 kg a.i. per hectare over that of 0.0 and 3.0 kg a.i. per hectare.

Effect of times of application :

Times of application did not affect mean plant number per plot significantly.

Effect of interaction :

None of the interaction effects was found to be significant.

3. Growth studies :

Growth studies include observations regarding growth characters, namely plant height, number of functional leaves, leaf area of functional leaves per plant and dry matter accumulation per plant and its part at different stages of growth. Studies on growth functions included Absolute Growth Rate(AGR) of height and dry matter per plant, Relative Growth Rate (RGR) and Net Assimilation Rate (NAR) of dry matter per plant.

3:1. Height of plant :

Height of a plant, shows the elongation of stem of a plant and hence measures growth. Data on the mean height of plant as affected periodically by different treatments are presented in Table 9.

Table 9 shows that the mean height of plant was found to increased with the age of the crop. The rate of increase was more between 45 to 60 days. On an average the maize plant achieved the mean maximum height of 198.85 cm at 90 days after

Table 9 : Mean height of plant in cm as affected periodically by treatments.

Treatments	Days after sowing				
	30	45	60	75	90
Weedicides					
S	19.05	50.40	145.18	193.96	195.52
A	20.48	57.83	164.88	200.72	202.19
'F' test	Sigt	Sigt	Sigt	N.S.	N.S.
S.E. ±	0.33	1.70	3.13	2.60	2.59
C.D.at 5%	0.91	4.71	8.68	-	-
Concentrations					
D_0	19.92	53.95	155.01	191.73	194.63
D_1	20.11	56.40	157.98	200.13	201.55
D_2	18.98	51.35	151.68	200.03	201.24
D_3	20.03	54.76	155.45	197.47	199.00
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
S.E. ±	0.48	2.40	5.01	3.68	3.66
C.D.at 5%	-	-	-	-	-
Times of application					
T_0	19.29	51.85	154.13	197.83	199.20
T_1	19.25	51.66	149.65	195.44	196.50
T_2	20.75	58.84	161.32	198.75	200.87
'F' test	Sigt	Sigt	N.S.	N.S.	N.S.
S.E.±	0.41	2.08	4.34	3.19	3.17
C.D. at 5%	1.14	5.76	-	-	-
Interation	N.S.	N.S.	N.S.	N.S.	N.S.
General Mean	19.76	54.11	155.03	197.34	198.85

N.S. = Non-significant

Sigt.= Significant.

sowing. The mean maximum height recorded at 90 days can be considered as resulted from the overall effects of the treatments.

Effect of weedicides :

Atrazine significantly increased theheight of plant at 30, 45 and 60 days i.e. before silking of maize plant as compared to that with simazine. But it was not affected significantly after 60 days onward by the weedicides. It tended to be higher in atrazine treated plots than those treated with simazine at 90 days.

Effect of concentrations :

The concentrations of weedicides did not affect the periodical height of plant significantly at any stage of observation.

Effect of times of application :

Times of application significantly affected the mean maximum plant height at 30 and 45 days only. At this stage pre plus post emergence was significantly superior to pre and post emergence singly. While pre and post emergence treatments individually were at par with each other. After 45 days the times of application did not affect the mean height of plant significantly.

Effect of interactions :

None of the interaction effects was found to be significant.

3:2. Absolute Growth Rate (AGR) of height of plant :

Data regarding mean AGR of height per week per plant as affected periodically by different factors are presented in Table 10. Data were not statistically analysed. Inferences are drawn from the mean values.

Data in Table 10 would show that the mean maximum AGR of height was observed to be 47.15 cm per plant per week during 45 to 60 days, followed by 19.76 cm per plant per week during 60 to 75 days. The lowest mean AGR value was observed to be 0.70 cm per plant per week during 75 to 90 days.

Effect of weedicides :

The AGR values were higher in atrazine treated plots during 30 to 60 days than those with simazine. There after reverse trend was recorded.

Effect of concentrations :

The AGR values upto 60 days among various concentrations did not show large fluctuations. There after no regular trend was observed.

Effect of times of application :

Pre plus post emergence and pre emergence had the highest AGR values upto 60 days than that of post emergence. It was increased with pre and post emergence during 60 to 75 days and decreased during 75 to 90 days as compared to pre plus post emergence.

Table 10 : Absolute growth rate (AGR) of height in cm per plant per week as affected periodically by treatments.

Treatments	Days after sowing			
	30:45	45:60	60:75	75:90
Weedicides				
A S	14.64	44.28	22.79	0.72
A	17.45	50.02	16.74	0.68
Concentrations				
D_0	15.90	47.22	17.15	3.22
D_1	16.95	47.46	19.69	0.66
D_2	15.12	46.88	22.59	0.56
D_3	16.22	47.05	19.63	0.71
Times of application				
T_0	15.21	47.79	20.42	0.64
T_1	15.14	45.78	21.39	0.49
T_2	17.79	47.88	17.49	0.99
General Mean	16.04	47.15	19.76	0.70

3:3. Functional leaf number per plant :

Data regarding mean number of functional leaves per plant as affected periodically by different treatments are presented in Table 11.

Data in Table 11 would reveal that the maize plant had borne the mean maximum leaves of 14.35 during 60 days.

Effect of weedicides :

The differential effects of weedicides on leaf number was not evident at any of the stages of crop growth. However, it was higher in atrazine treated plots than that in simazine treated ones.

Effect of concentrations :

Different concentrations did not differ significantly in influencing the mean number of leaves per plant at any of the stages of crop growth.

Effect of times of application :

Times of application did not affect significantly the mean leaf number per plant at any of the stages of growth. However, the leaf number per plant was more with pre plus post emergence than those of pre and post emergence, and between pre and post emergence treatments, pre emergence was comparatively better than the post emergence.

Effect of interaction :

The interaction between weedicides and concentrations was significant at 60 days only. Similarly the interaction between the concentrations and times of application was

Table 11 : Mean number of functional leaves per plant as affected periodically by treatments.

Treatments		Days after sowing				
		30	45	60	75	90
Weedicides						
	S	8.02	11.09	14.05	13.01	12.94
S	A	8.03	11.67	14.65	13.21	13.19
	'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
	S.E. ±	0.30	0.50	0.46	0.31	0.35
	C.D. at 5 %	-	-	-	-	-
Concentrations						
	D_0	8.05	11.05	13.94	13.06	13.01
	D_1	7.94	11.47	14.33	13.13	13.11
	D_2	8.13	11.46	14.45	13.25	13.08
	D_3	8.00	11.53	14.67	13.12	13.04
	'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
	S.E. ±	0.44	0.71	0.66	0.45	0.5
	C.D. at 5 %	-	-	-	-	-
Times of application						
	T_0	8.01	11.23	14.43	13.09	13.01
	T_1	7.94	11.17	14.14	13.03	12.9

Table 11 (Continued)

Treatments	Days after sowing: 30	45	60	75	90
Times of application (Contd.)					
T_2	8.34	11.74	14.48	13.19	13.16
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
S.E. ±	0.37	0.65	0.97	0.39	0.41
C.D. at 5 %	-	-	-	-	-
Interactions					
MXD					
'F' test	N.S.	N.S.	Sigt	N.S.	N.S.
S.E. ±	-	-	0.094	-	-
C.D. at 5 %	-	-	0.258	-	-
DXT					
'F' test	N.S.	N.S.	N.S.	Sigt	N.S.
S.E. ±	-	-	-	0.774	-
C.D. at 5 %	-	-	-	2.148	
General Mean			14.35	13.10	

N.S. = Not significant

Sigt = Significant.

significant at 75 days. At final stage none of the interaction effects was found to be significant.

3:4. Leaf area per plant :

Data regarding mean leaf area per plant recorded periodically in various treatments are presented in Table 12.

Table 12 would reveal that, on an average maize plant achieved the mean maximum leaf area of 55.75 sq dm on the 75th day. The leaf area per plant was increased upto 75 days. After this, at final stage, leaf area per plant was decreased due to drying of older leaves.

Effect of weedicides :

The leaf area per plant was found to be higher with atrazine than that with simazine at all stages of growth.The difference between the two was not significant.

Effect of concentrations :

The consentrations did not differ significantly among one another in influencing the leaf area per plant at all stages of observations.

Effect of times of application :

The leaf area per plant was not affected significantly by the times of application.

Effect of interaction :

Interaction effects were found to be not significant at any of the stages of observations.

Table 12 : Mean leaf area per plant in (sq dm) recorded periodically as affected by treatments.

Treatments	Days after sowing				
	30	45	60	75	90
Weedicides					
S	11.49	34.73	49.42	53.12	45.80
A	12.41	37.00	55.04	58.28	51.86
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
S.E. ±	0.64	1.17	1.21	1.33	4.84
C.D. at 5 %	-	-	-	-	-
Concentrations					
D_0	12.03	36.47	50.74	55.10	45.31
D_1	12.11	35.75	52.83	57.25	48.84
D_2	11.73	35.16	53.64	56.35	55.31
D_3	11.93	36.09	51.38	54.30	45.26
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
S.E. ±	0.90	1.34	1.72	1.86	6.37
C.D. at 5 %	-	-	-	-	-
Times of application					
T_0	11.94	36.21	52.39	57.04	50.88
T_1	11.02	34.89	49.70	52.11	43.20
T_2	12.89	36.50	54.60	58.10	52.43
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
S.E. ±	0.78	0.95	1.49	1.61	5.93
C.D.at 5 %	-	-	-	-	-
Interactions	N.S.	N.S.	N.S.	N.S.	N.S.
General Mean	11.95	35.87	52.23	55.75	48.84

N.S. = Not significant Sigt = Significant.

3:5. Leaf Area Index (LAI) :

Data regarding mean LAI as influenced periodically by various treatments are presented in Table 13. Data were not statistically analysed. Inferences are drawn from the mean values.

Table 13 would reveal that the mean maximum LAI of 2.48 was recorded at 75 days. LAI values increased upto 75 days and decreased at 90 days of observation, as there was reduction in the leaf number and thereby leaf area per plant.

Effect of weedicides :

The LAI values were higher with atrazine treated plots than those in simazine treated plots, throughout the life period of the crop.

Table 13 : Mean leaf area index (LAI) as affected periodically treatments.

Treatments	Days after sowing				
	30	45	60	75	90
Weedicides					
S	0.51	1.54	2.20	2.37	2.04
A	0.55	1.64	2.45	2.59	2.31
Concentrations					
D_0	0.53	1.62	2.26	2.49	2.01
D_1	0.54	1.59	2.35	2.54	2.17
D_2	0.52	1.56	2.38	2.50	2.46
D_3	0.53	1.61	2.28	2.41	2.01
Times of application					
T_0	0.53	1.61	2.33	2.54	2.26
T_1	0.49	1.55	2.21	2.32	1.92
T_2	0.57	1.62	2.42	2.58	2.33
General Mean	0.53	1.59	2.32	2.48	2.17

Effect of concentrations :

The LAI values did not show large fluctuations among various concentrations.

Effect of times of application :

Pre plus post emergence had higher LAI values than those of pre and post emergence application of weedicides.

3:6. Dry matter per plant :

Data on mean dry matter per plant and it's component parts as influenced periodically by various treatments are presented in Table 14.

Table 14 would reveal that mean dry matter per plant was increased with the age of the maize plant. The mean maximum total dry matter per plant recorded at 90 days was 276.10 gm. The distribution of total dry matter of individual plant parts also showed an increasing trend with increase in the age of the crop and reached the maximum at 90 days of observation.

3:6:1. Dry matter of leaves :

The mean maximum dry matter of leaves was recorded to be 64.73 gm at 90 days.

Effect of weedicides :

The mean dry matter of leaves per plant was higher with atrazine treated plots than those with simazine at all stages of growth. The difference between the two was significant only at 60Odays.

Effect of concentrations :

Different concentrations were not found to be significant different from one another throughout the growth period of the crop. However, concentration of 2.0 kg a.i. per hectare produced more dry matter of leaves per plant at 90 days than the rest.

Effect of times of application :

Times of application did not affect significantly the dry matter of leaves per plant at any stages of observations. In general, pre plus post emergence produced higher dry matter of leaves at 90 days over others.

Effect of interactions :

None of the interaction effects was found to be significant at any of the stages of observations.

3:6:2. Dry matter of stem :

The mean maximum dry matter of stem recorded was 74.41 gm on the 90 day of observation.

Effect of weedicides :

The effect of weedicides was not evident at any stage of observations. In general, atrazine treated plots had higher values than those of simazine.

Effect of concentrations :

The concentration of 1.0 kg a.i. per hectare was found to be significant at 60 days. Except the 60 days, it was not found to be significant at any stage of observation. However,

mean dry matter of stem was found to be higher with the concentration of 2.0 kg a.i. per hectare over others.

Effect of times of application :

Times of application did not affect significantly the dry matter of stem recorded periodically.

Effect of interaction :

The interaction effects between weedicides and times of application was found to be significant at 30, 75 and 90 days of observations. Atrazine at 2.0 kg a.i. per hectare was only found to be significant at 30, 75 and 90 days over others. The rest of interactions were found to be not significant.

3:6:3. Dry matter of reproductive parts :

The plant started accumulating dry matter in reproductive parts from 60 days onwards. The mean maximum dry matter of reproductive parts was 136.96 gm at 90 days.

Effect of weedicides :

Effect of weedicides on the dry matter of reproductive was not found to be evident at any stage of observation. However, atrazine treated plots produced higher dry matter of reproductive parts than those of simazine throughout the life period of the crop.

Effect of concentrations :

It was not affected significantly by the concentrations at any stage of observation. In general, 2.0 and 3.0 kg

a.i. per hectare produced more dry matter of reproductive parts at 90 days over other concentrations.

Effect of times of application :

Times of application did not affect it significantly at any stage of growth. In general, pre plus post emergence produced more dry matter of reproductive parts at 90 days over the rest.

Effect of interactions :

None of the interaction effects was found to be significant.

3:6:4. Total dry matter per plant :

The mean maximum total dry matter per plant was recorded to be 276.10 gm at 90 days.

Effect of weedicides :

Weedicides did not affect the total dry matter per plant significantly at any stage of observation.

Effect of concentrations :

The concentrations were equivalent in effect at all stages of observations.

Effect of times of application :

Times of application did not affect it significantly. However, pre plus post emergence treatment produced more total dry matter than those of pre and post emergence.

Effect of interactions :

Interaction effects were found to be not significant.

3:7. Absolute Growth Rate (AGR) of dry matter :

Data pertaining to AGR of dry matter in gm per plant per week as influenced by various treatments are presented in Table 15. Data were not analysed statistically. Inferences are drawn from the mean values.

A glance at Table 15 would indicate that the mean AGR value was found to increase upto 75 days and there after showed a decreasing trend.

Effect of weedicides :

AGR values were higher with atrazine treated plots than those with simazine at all stages except those between 60 and 75 days.

Effect of concentrations :

AGR was higher with the concentrations of 2.0 and 3.0 kg a.i. per hectare than those of 0.0 and 1.0 kg a.i. per

Table 15 : Mean (AGR) of dry matter in gm pe
per week as affected periodically by

Treatments	Days after sowing			
	30-45	45-60	60-75	75-90
Weedicides				
S	11.21	28.75	46.65	37.45
A	12.00	33.03	46.01	38.79
Concentrations				
D_0	10.76	31.41	45.61	30.07
D_1	11.03	31.53	44.79	36.63
D_2	12.48	28.35	51.56	38.85
D_3	12.14	32.27	43.49	41.57
Times of application				
T_0	11.20	29.22	51.06	32.57
T_1	11.01	31.73	45.38	38.53
T_2	12.57	31.71	42.83	43.07
General Mean	11.60	30.99	46.33	38.18

are presented in Table 16. Data were not analysed statistically. Inferences are based on mean values.

Table 16 would indicate that mean RGR of 0.8904 gm/gm per week per plant was observed during 30 to 45 days. It went on decreasing as the age advanced and was the lowest between 75 and 90 days of crop growth.

Effect of Weedicides :

RGR was higher with atrazine treated plots upto 60 days, but thereafter it was lower as compared to those treated with simazine.

Effect of concentrations :

Concentration of 2.0 kg a.i. per hectare the mean RGR values were higher between 30 and 45 days and thereafter the trend of RGR was irregular as compared with to rest of concentrations.

Effect of times of application :

Times of application did not show a consistant trend in RGR values recorded periodically.

3.9. Net Assimilation Rate (NAR) of dry matter :

Data regarding the mean NAR of dry matter in gm/sq dm per plant per week recorded periodically in various treatment are presented in Table 17. Data were not analysed statistically. Inferences are based on mean values.

A glance at Table 17 would reveal that the mean NAR was increased upto 75 days and thereafter went on decreasing. Mean maximum NAR was recorded during 60 to 75 days.

Table 16 : Mean (RGR) of dry matter in gm/gm per plant per week as affected periodically by treatments.

Treatments		Days after sowing			
		30-45	45-60	60-75	75-90
Weedicides	S	0.8909	0.5411	0.3495	0.1628
	A	0.8914	0.5637	0.3189	0.1626
Concentrations					
D_0		0.8572	0.5790	0.3301	0.1361
D_1		0.8797	0.5721	0.3250	0.1803
D_2		0.9263	0.5070	0.3693	0.1610
D_3		0.8978	0.5534	0.3084	0.1717
Times of application					
T_0		0.9011	0.5478	0.3259	0.1602
T_1		0.8916	0.5792	0.3255	0.1648
T_2		0.8768	0.5341	0.3047	0.1839
General Mean		0.8904	0.5533	0.3335	0.1638

Table 17 : Mean NAR of dry matter in gm per sq dm leaf area per plant per week as affected periodically by treatments.

Treatments	Days from sowing			
	30-45	45-60	60-75	75-90
Weedicides				
S	0.5336	0.6906	0.9116	0.7587
A	0.5333	0.7273	0.8112	0.7056
Concentrations				
D_0	0.4883	0.8744	0.8565	0.5957
D_1	0.5053	0.7205	0.8170	0.6919
D_2	0.5678	0.6486	0.9379	0.6970
D_3	0.5564	0.7458	0.8233	0.8376
Times of application				
T_0	0.5121	0.6671	0.9359	0.6038
T_1	0.5317	0.7583	0.8545	0.8024
T_2	0.5542	0.7056	0.7384	0.7144
General Mean	0.5335	0.7089	0.8614	0.7822

Effect of weedicides :

The mean NAR values were higher in the plots treated with simazine from 60 days onward as compared to atrazine treated plots.

Effect of concentrations :

The mean NAR values were higher with concentration of 2.0 kg a.i. per hectare over the rest of concentrations throughout the growthp period of the crop except during 45 to 60 days.

Effect of times of application :

Post emergence application of weedicides, in general, increased the mean NAR values throughout the growth period of the crop except during 60 to 75 days.

4. Yield contributory characters :

Data pertaining to yield contributory characters namely mean number of cobs per plant, length of cob, number of grain rows per cob, weight per cob, weight of husk per cob, weight of heart and grains per cob as influenced by various treatments are presented in Table 18.

Table 18 would show that the maize plant on an average borne one cob. The average length of cob was 12.58 cm. The number of grain rows per cob was 13.84. It had 429.99 grains per cob. Weight of cob was 101.38 gm while the husk weight was 20.98 cm . The heart per cob was 19.34 gm and weight of grains per cob was 81.93 gm .

4:1. Mean number of cobs per plant :

It would be observed from data presented in Table 18 that the mean number of cobs was not affected significantly by weedicides, their concentrations and times of application.

4:2. Length of cob :

Effect of weedicides :

Weedicides did not affect the length of cob significantly.

Effect of concentrations :

The concentrations under study did not influence the length of cob significantly.

Effect of times of application :

Times of application did not affect the length of cob significantly.

Effect of interactions :

None of the interaction effects was found to be significant.

4:3. Number of grain rows per cob :

Effect of weedicides :

The number of grain rows per cob was not affected significantly by weedicides. However, atrazine treated plots shows higher number of grain rows than those with simazine.

Effect of concentrations :

The number of grain rows per cob was not affected significantly by various concentrations of weedicides.

Effect of times of application :

The grain rows per cob was not affected significantly by the times of weedicides applied.

Effect of interactions :

None of the interaction effects was found to be significant.

4:4. Number of grains per cob :

Effect of weedicides :

The grain number per cob was not affected significantly by the weedicides.

Effect of concentrations :

The concentrations did not produce differential effect in influencing the grain number per cob.

Effect of times of application :

Times of application did not effect the number of grains per cob significantly.

Effect of interactions :

All the interaction effects involved in the experiment were found to be not significant.

4:5. Weight per cob (gm) :

Effect of weedicides :

The weedicides did not affect the weight of cob significantly. However, atrazine treated plots produced more weight of cob than those with simazine.

Effect of concentrations :

The weight of cob was affected significantly by the concentrations of weedicides. The concentration of 2.0 kg a.i. per hectare was significantly superior to the control and 1.0 kg a.i. per hectare. While differences in weight of cob due to 2.0 and 3.0 kg a.i. per hectare as well as 3.0 and 1.0 kg a.i. per hectare were at par.

Effect of times of application :

Times of application did not affect the weight of cob significantly. However,the highest weight of cob was produced by pre emergence application.

Effect of cp interactions :

The interaction between weedicides and concentrations was found to be significant.

The relevant data are presented in Table 19.

Table 19 : Mean weight of grains per cob in gm as affected by weedicides and their concentrations.

	D_0	D_1	D_2	D_3
S	65.19	79.38	88.22	79.62
A	88.16	79.73	94.60	80.66

S.E. ± = 5.02

C.D.at 5 % = 13.91

Table 19 shows that atrazine at the rate of 2.0 kg

a.i. per hectare was found to be significantly superior to those of SD_0, SD_1, SD_3, AD_1 and AD_3. While SD_1, SD_2, SD_3, AD_0, AD_1 and AD_3 were also found significant superior to that of SD_0. The rest of interactions were found to be at par.

4:6. Weight of husk per cob (gm) :

Effect of weedicides :

The weedicides under study did not affect the weight of husk per cob significantly.

Effect of concentrations :

Concentrations did not influence the weight of husk per cob significantly.

Effect of times of application :

Times of application did not affect the weight of husk per cob significantly.

Effect of interactions :

None of the interaction effects was found to be significant.

4:7. Weight of heart per cob (gm) :

Effect of weedicides :

The weedicides did affect the weight of heart per cob significantly. Atrazine was found to be significantly superior to simazine.

Effect of concentrations :

The concentrations did not affect the weight of heart

per cob significantly. However, it was the highest with the concentration of 2.0 kg a.i. per hectare among all.

Effect of times of application :

Times of application did not affect the weight of heart per cob significantly.

Effect of interactions :

Interaction effects was found to be not significant.

4.8. Weight of grains per cob (gm) :

Effect of weedicides :

The weight of grains per cob was not affected significantly by weedicides.

Effect of concentrations :

The weight of grains per cob was affected significantly by the concentrations. The concentration of 2.0 kg a.i. per hectare was significantly superior to 0.0, 1.0 and 3.0 kg a.i. per hectare. While the concentrations namely 0.0, 1.0 and 3.0 kg ai. per hectare were at par.

Effect of times of application :

The times of application did not affect the weight of grains per cob significantly.

Effect of interactions :

The interaction between concentrations of weedicides and their times of application was found to be significant. The relevant data are presented in Table 20.

Table 20 : Mean weight of per cob gm as affected by concentrations of weedicides and their times of application.

	D_0	D_1	D_2	D_3
T_0	91.66	102.00	108.67	119.87
T_1	100.20	101.00	109.00	85.10
T_2	79.03	95.87	118.80	108.15

S.E. ± = 7.33

C.D. at 5 % = 20.32

Table 20 shows that weedicides at the rate of 3.0 and 2.0 kg a.i. per hectare as pre emergence and pre plus post emergence significant superior to those of D_0 T_0, D_0 T_2, D_1 T_2 and D_3 T_1 respectively. While the concentration of weedicides at the rate of D_0 T_1, D_1 T_0, D_1 T_1, D_2 T_0, D_2 T_1 and D_3 T_2 were also found to be significantly superior to D_0 T_2 and D_3 T_1 respectively. The rest of interactions were found to be nonpar.

4.9. Weight of cobs per plot (kg) :

Data regarding weight of cobs per plot are presented in Table 21.

Table 21 shows that the average weight of cobs per plot was 10.90 kg .

Effect of weedicides :

The weedicides did not affect the weight of cobs per plot significantly.

Table 21 : Weight of cobs (in kg) per plot as influenced by various treatments.

Treatments	Weight of cobs (in kg)
Weedicides	
S	10.66
A	11.13
'F' test	N.S.
S.E. ±	0.39
C.D. at 5 %	-
Concentrations	
D_0	10.45
D_1	10.80
D_2	11.56
D_3	10.77
'F' test	N.S.
S.E. ±	0.55
C.D. at 5 %	-
Times of application	
T_0	11.43
T_1	10.66
T_2	10.60
'F' test	N.S.
S.E. ±	0.28

Effect of concentrations :

The concentrations of weedicides were equivalent in effect.

Effect of times of application :

The times of application did not affect the weight of cobs per plot significantly.

Effect of interactions :

None of the interaction effects was found to be significant.

4:10. Yield of grains, fodder and heart per plot, grain to cob ratio and thousand grain weight :

The relevant data are presented in Table 22. Data regarding grain to cob ratios were not analysed statistically. Means are used to interprete the results.

Data presented in Table 22 would reveal that the yield of grain, fodder and heart per plot, and grain to cob ratio were 8.74, 14.53 and 2.04 kg per plot and 0.80 respectively. The mean thousand grain weight was recorded to be 239.93 gm .

4:10:1. Yield of grains per plot (kg) :

Effect of weedicides :

The grain yield per plot was not affected significantly by the weedicides under study. However, it was numerically higher in atrazine treated plots than that with simazine.

Effect of concentrations :

The grain yield per plot was not affected significantly

by the concentrations of weedicides. However concentration of 2.0 kg a.i. per hectare produced higher grain yield per plot than the rest.

Effect of times of application :

Differences in yield of grain due to times of application were found to be not significant. In general, pre emergence application produced more yield of grains than that with post emergence and pre plus post emergence sprays.

Effect of interactions :

The interaction of weedicides and their concentration was found to be significant. The relevant data are presented in Table 23.

Table 23 : Mean yield of grains per plot (kg) as affected by weedicides and their concentrations.

	D_0	D_1	D_2	D_3
S	7.97	7.95	8.86	9.00
A	8.23	9.53	10.24	8.20

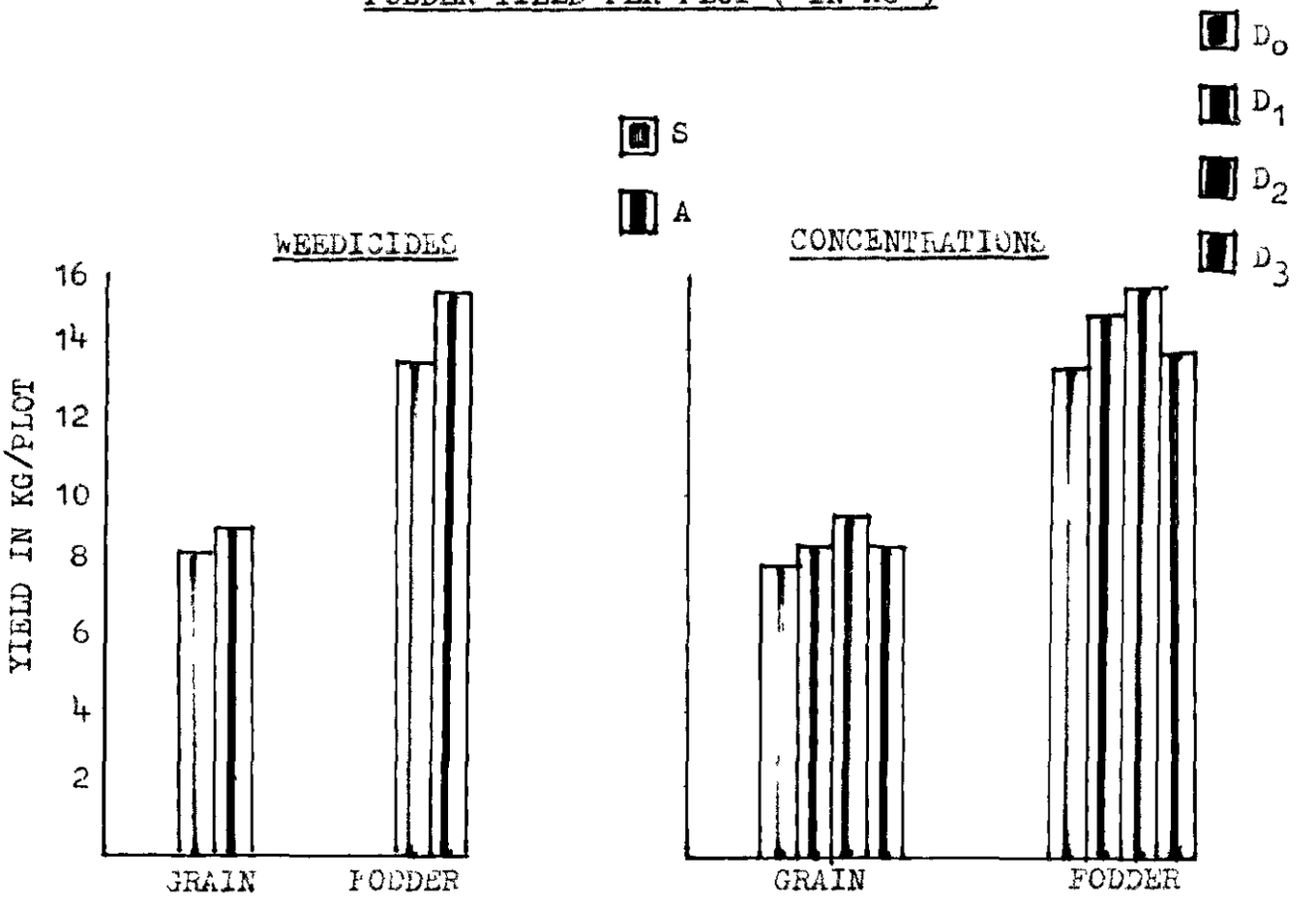
S.E. ± = 0.608

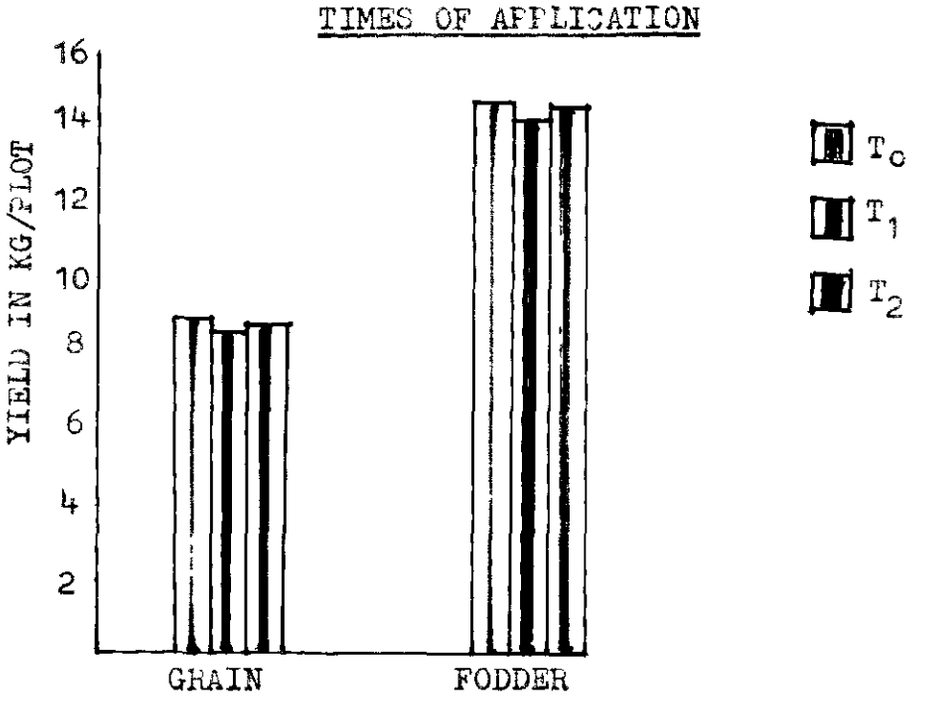
C.D. at 5 % = 1.685

Table 23 shows that atrazine at the rate of 2.0 kg a.i. per hectare significantly superior to those of SD_0, SD_1, AD_0 and AD_3. The rest of the combinations were found to be at par.

FIG.2

INFLUENCE OF VARIOUS FACTORS ON GRAIN AND FODDER YIELD PER PLOT (IN KG)





4:10:2. Yield of fodder (kg) :

Effect of weedicides :

The fodder yield per plot was not affected significantly by the weedicides.

Effect of concentrations :

Various concentrations of weedicides did not affect the yield of fodder per plot significantly.

Effect of times of application :

The times of application did not affect the yield of fodder per plot significantly. In general, pre emergence and pre plus post emergence applications produced higher fodder yield than that of post emergence.

Effect of interactions :

None of the interaction effects was found to be significant.

4:10:3. Weight of heart per plot (kg) :

Effect of weedicides :

Weedicides did not affect the weight of heart per plot significantly. However, atrazine treated plots produced more weight of heart than those with simazine.

Effect of concentrations :

Differences in the weight of heart per plot as influenced by concentrations of weedicides were found to be not significant. However,2 kg a.i. per hectare produced more weight of heart per plot as compared to the rest of the concentrations.

Effect of times of application :

Times of application did not affect the weight of heart per plot significantly.

Effect of interactions :

Interaction effects were found to be not significant.

4:10:4. Grain to cob ratio :

Effect of weedicides :

Atrazine treated plots showed higher grain to cob ratio than that with simazine.

Effect of concentrations :

The grain to cob ratios went on widening, in general as the concentrations was increased.

Effect of times of application :

The lowest grain to cob ratio was recorded in the pre emergence treatment. In post emergence and pre plus post emergence treatments, it was higher than that with pre emergence but in the former two, it was identical.

4:10:5. Thousand grain weight (gm) :

Weedicides did not influence the thousand grain weight significantly. However, it was more with atrazine treated plots than that with simazine.

Effect of concentrations :

Various concentrations of weedicides did not affect it significantly.

Effect of times of application :

The times of application did not affect the thousand grain weight significantly.

Effect of interactions :

None of the interaction effects was found to be significant.

5. Studies on weeds :

5:1. Effects of treatments on number of weeds :

Data pertaining to mean number of weeds per plot (1 M^2) obtained at 15 and 30 days after sowing as influenced by various treatments are presented in Table 24. The relevant data are presented in figure 3.

Effect of weedicides :

The number of weeds per plot as affected by weedicides was found to be significantly affected at both the stages. Atrazine was significantly superior to simazine in the control of weeds at both the stages.

Effect of concentrations :

The concentrations of weedicides affected the mean number of weeds per plot significantly at both the stages. On the 15th day, the concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare were significantly superior to 0.0 kg a.i. per hectare in reducing the weed population. While 1.0, 2.0 and 3.0 kg a.i. per hectare were at par. Likewise on the 30th day, the concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare were also significantly superior to the control in

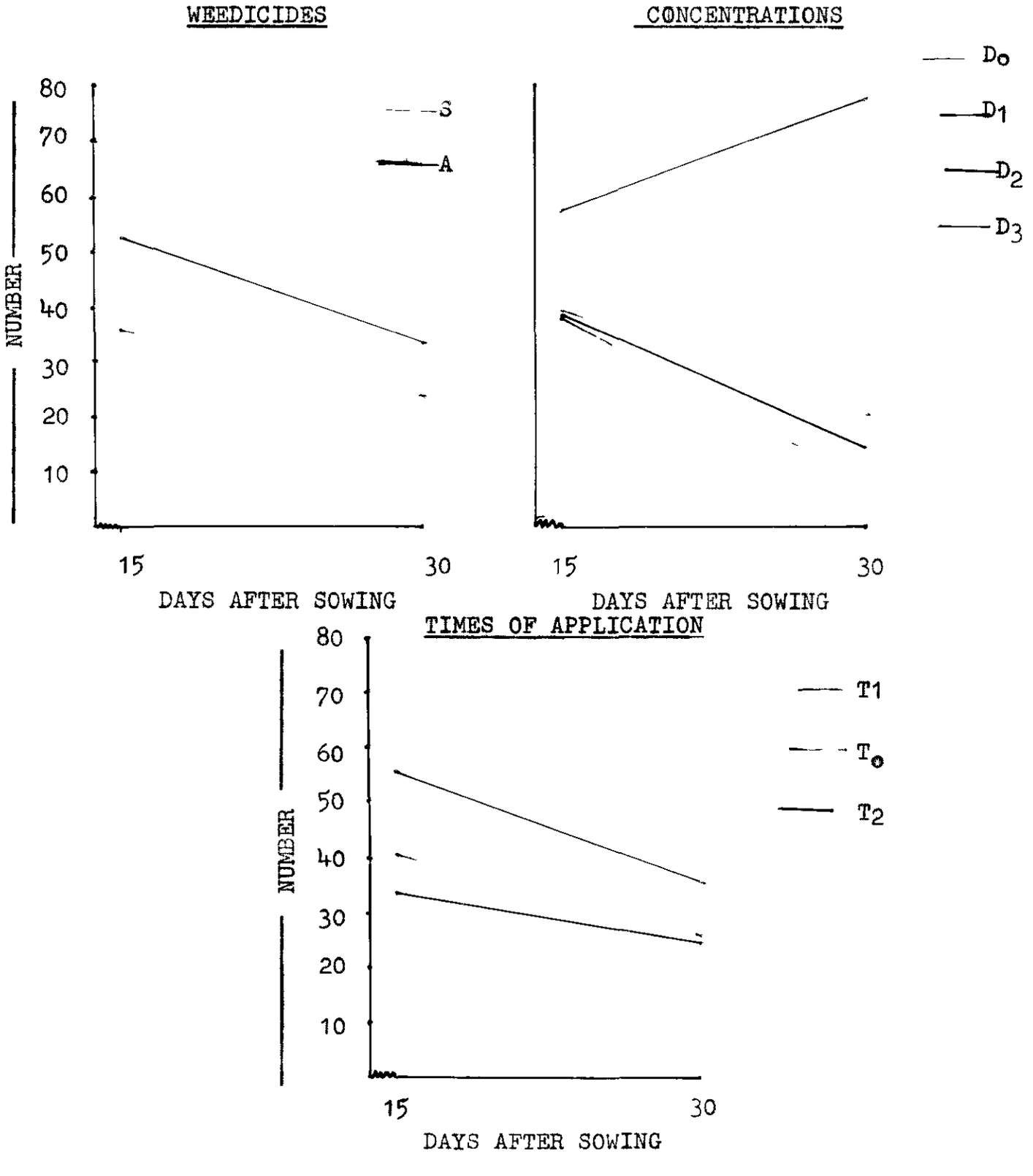
Table 24 : Intensity of weeds per plot (1 M^2)area) as affected by treatments.

Treatments	Days after sowing	
	15	30
Weedicides		
S	52.16	33.86
A	32.25	23.63
'F' test	Sigt	Sigt
S.E. ±	3.77	1.74
C.D. at 5 %	14.20	4.83
Concentrations		
D_0 (control)	57.72	72.11
D_1	39.38	20.50
D_2	39.11	14.27
D_3	38.61	8.11
'F' test	Sigt	Sigt
S.E. ±	5.33	2.47
C.D. at 5 %	14.77	6.84
Times of application		
T_0	40.83	26.79
T_1	56.75	35.12
T_2	33.54	24.33
S.E. ±	Sigt	Sigt
C.D. at 5 %	11.40	5.92
Interactions	N.S.	N.S.
General Mean	43.70	28.75

N.S. = Not significant Sigt = Significant.

FIG.3

EFFECTS OF VARIOUS FACTORS ON WEED DENSITY



reducing the weed population. The concentration of 3.0 kg a.i. per hectare was significantly superior to 1.0 kg a.i. per hectare. While the 2.0 and 3.0 kg a.i. per hectare was at par.

Effect of times of application :

Times of application were found to affect the weed population significantly at 15 and 30 days. Pre emergence and pre plus post emergence were significantly superior to post emergence at both stages of observations. While, the effect of pre emergence and pre plus post emergence was at par on both 15 and 30 days. At 15 days only pre emergence treatment was made. Hence in the treatment of pre plus post emergence treatment, the effect of post emergence was not existing. The post emergence treatment was as good as the control since the post emergence spray was not made by the 15th day.

Effect of interactions :

None of the interaction effects was found to be significant.

5.2. Effect of treatments on air dry weight of weeds :

Data regarding air dry weight of weeds per plot at 95 days after sowing as affected by various treatments are presented in Table 25. On an average the air dry weight of weeds at 95 days was observed to be 7.20 kg per plot.

Table 25 : Weight of air dry weeds in kg per plot as affected by treatments.

Treatments	Weight of air dry weeds
Weedicides	
S	7.72
A	6.69
'F' test	N.S.
S.E. ±	0.73
C D. at 5 %	-
Concentrations	
D_0	13.69
D_1	5.80
D_2	4.66
D_3	4.11
'F' test	Sigt
S.E. ±	1.03
C.D. at 5 %	2.85
Times of application	
T_0	6.95
T_1	7.87
T_2	6.79
'F' test	N.S.
S.E. ±	0.89
C.D. at 5 %	-
Interactions	N.S.
General Mean	7.20

N.S. = Not significant Sigt = Significant.

5:3. Effect of weedicides, their concentrations and times of application on the removal of nutrients through weeds :

Ten representative samples of weeds were taken for the determination of nitrogen, P_2O_5 and K_2O in weeds.

From this, mean percentages of nitrogen, P_2O_5 and K_2O in weeds were estimated.

Data regarding the quantities of nitrogen, P_2O_5 and K_2O removed by weeds as influenced by various treatments are presented in Table 26. Data were not analysed statistically. Inferences are drawn from the mean values. Data are presented graphically in figure 4.

Table 26 : Effects of treatments on removal of nitrogen P_2O_5 and K_2O by weeds in kg per hectare.

Treatments	Nutrients removed(in kg) per ha.		
	N	P_2O_5	K_2O
Weedicides			
S	67.38	41.78	71.47
A	60.42	34.12	64.21
Concentrations			
D_0	129.68	63.57	131.13
D_1	59.06	37.13	63.00
D_2	37.84	28.10	39.13
D_3	29.02	25.00	39.10
Times of application			
T_0	50.20	35.23	70.68
T_1	81.36	40.86	82.12
T_2	57.14	39.26	50.72
General Mean	63.90	38.45	67.84

5:3:2. Effect on P_2O_5 removed by weeds :

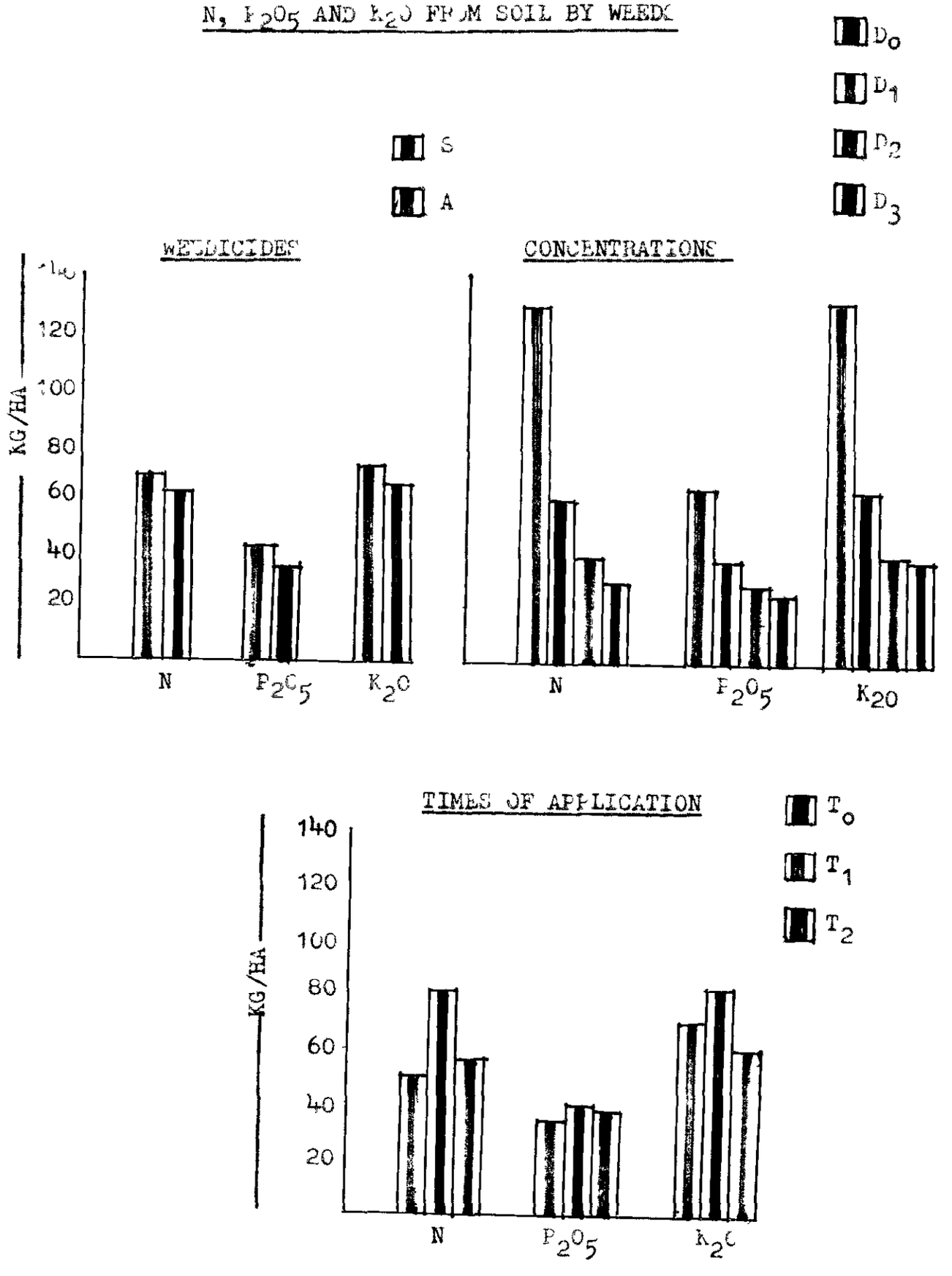
A glance at Table 26 would indicate that on an average 38.45 kg P_2O_5 removed by weed per hectare was removed by weeds.

The quantity of P_2O_5 removed by weeds with simazine treated plots was higher than that with atrazine treated ones.

The control plot in which growth of weeds was undisturbed removed more quantity of P_2O_5 than those from the

FIG. 4

INFLUENCE OF VARIOUS FACTORS ON REMOVAL OF N, P_2O_5 AND K_2O FROM SOIL BY WEEDS



concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare. Increase in the concentration of weedicide decreased the quantity of P_2O_5 removed by weeds.

The quantity of P_2O_5 removed by weeds from post emergence treatment was the highest among all the treatments. The next in order was the pre plus post emergence treatment followed by pre emergence treatment.

5:3:3. Effect of K_2O removed by weeds :

It is clear from data in Table 26 that on an average weeds removed 67.84 kg K_2O per hectare.

The quantity of K_2O removed by weeds was higher with simazine than that from atrazine treated plots. The quantities of K_2O removed by weeds was the highest from the control plot. The lowest quantity of K_2O was removed from the plot treated with the concentration of 3.0 kg a.i. per hectare. Increase in the concentration of weedicides decreased the quantity of K_2O removed by weeds.

In pre plus post emergence treatment, the quantity of K_2O removed by weeds was the lowest. While the highest quantity of K_2O was removed by weeds from the treatment of post emergence application, intermediate values being from the plots treated with pre emergence application.

5:4. Weed Index (W.I.) :

Data pertaining to the weed indicates per plot in various treatments are presented in Table 27. Data were not analysed statistically. Inferences are based on mean yield values per hectare.

i.e. 0.0 and 3.0 kg a.i. per hectare.

Effect of times of application :

Pre emergence application was observed to be very effective because it had the lowest weed index than post and pre plus post emergence applications. Among post and pre plus post emergence, pre plus post emergence was observed to be more effective.

6. Soil moisture studies :

6:1. Moisture content of soil :

Data regarding the moisture percentage of soil as affected by various treatments at harvest are presented in Table 28.

Table 28 would shows that mean soil moisture percentage at harvest was 11.19.

Effect of weedicides :

Soil moisture at harvest was not affected significantly by weedicides. However, simazine treated plots contained more soil moisture percentage than those with atrazine.

Effect of concentrations :

Differences in soil moisture percentage were not significantly affected by various concentrations of weedicides. However, concentration of 1.0 kg a.i. per hectare contained more soil moisture percentage than the control and 3.0 kg a.i. per hectare.

Table 28 : Mean soil moisture percentage per plot as affected by various treatments at harvest.

Treatments	Soil moisture at harvest
Weedicides	
S	11.23
A	11.16
'F' test	N.S.
S.E. ±	0.05
C.D. at 5 %	-
Concentrations	
D_0	10.75
D_1	11.58
D_2	11.26
D_3	11.17
'F' test	N.S.
S.E. ±	0.07
C.D. at 5 %	-
Times of application	
T_0	11.50
T_1	10.62
T_2	11.45
'F' test	Sigt.
S.E. ±	0.06
C.D. at 5 %	0.16
Interactions	N.S.
General Mean	11.19

Sigt. = Significant N.S. = Not significant.

Effect of times of application :

Times of application affected the soil moisture percentage at harvest significantly. Both pre and pre plus post emergence applications were significantly superior to post emergence application. Pre and pre plus post emergence treatments were at par.

Effect of interactions :

None of the interaction effects was found to be significant.

6:2. Chemical studies :

6:2:1. Nitrogen percentage in different parts of maize plant :

Data regarding the mean percentage of nitrogen in different plant of maize at 90 days as affected by treatments are presented in Table 29. Data were not analysed statistically. Inferences are based on mean values.

6:2:2. Nitrogen percentage in leaves :

It is observed from Table 29 that the mean nitrogen percentage in leaves was found to be 1.051.

Effect of weedicides :

Atrazine treated plants had higher nitrogen percentage in leaves than those from simazine treated plants.

Effect of concentrations :

The nitrogen percentage in leaves was more from the plants treated with 1.0 and 2.0 kg a.i. per hectare than those with the control and 3.0 kg a.i. per hectare.

Table 29 : Mean percentage of nitrogen in leaves, stem and reproductive parts as affected by treatments at 90 days.

Treatments	Nitrogen percentage		
	Leaves	Stem	Reproductive parts
Weedicides			
S	1.015	0.593	0.645
A	1.087	0.521	0.641
Concentrations			
D_0	0.994	0.432	0.542
D_1	1.080	0.529	0.604
D_2	1.079	0.584	0.696
D_3	1.051	0.624	0.730
Times of application			
T_0	1.064	0.638	0.713
T_1	1.027	0.542	0.624
T_2	1.072	0.591	0.592
General Mean	1.051	0.557	0.643

Effect of times of application :

Pre plus post emergence application of weedicides resulted in producing the plants with leaves having higher nitrogen percentage than those from the post emergence and pre emergence applications.

6:2:3. Nitrogen percentage in stem :

Table 29 would show that the mean nitrogen percentage in stem was observed to be 0.557 at 90 days.

Effect of weedicides :

Nitrogen percentage in the stem of the plant was higher with simazine than that with atrazine treated plants.

Effect of concentrations :

Nitrogen percentage in the stem of the plant was increased with increase in the concentration of weedicide.

Effect of times of application :

Pre emergence application of weedicides increased the nitrogen percentage in the stem than that of post and pre plus post emergence treatment.

6:2:4. Nitrogen percentage in the reproductive parts of plant :

It is observed from Table 29 that nitrogen percentage in the reproductive parts was 0.643.

Effect of weedicides :

Nitrogen percentage in the reproductive parts was higher in the simazine treated plants than that with atrazine.

Effect of concentrations :

The highest concentration of weedicide namely 3.0 kg a.i. per hectare had higher nitrogen content in the reproductive parts than those of control, 1.0 and 2.0 kg. a.i. per hectare. In general, the percentage of nitrogen in the reproductive parts was increased with increase in the concentration of weedicides.

Effect of times of application :

Pre emergence application of weedicide was found to increase the percentage of nitrogen in the reproductive parts than post and pre plus post emergence applications.

6:2:5. Nitrogen percentage in grains :

Data pertaining to mean nitrogen percentage in grains as influenced by treatments are presented in Table 30. Data were not analysed statistically. The inferences are drawn from the mean values.

Effect of weedicides :

Nitrogen percentage in the maize grain was slightly increased with atrazine treated plants than that with simazin

Effect of concentrations :

Concentrations of 1.0 and 2.0 kg a.i. per hectare increased the nitrogen percentage in grain than those of the control and 3.0 kg a.i. per hectare. While, 2.0 kg a.i. per hectare had slightly increased it over 1.0 kg a.i. per hectar

Effect of times of application :

Pre plus post emergence treatment increased it over post and pre emergence treatments.

Table 30 : Nitrogen percentage in grains as influenced by treatments.

Treatments		Nitrogen percentage
Weedicides	S	1.30
	A	1.34
Concentrations		
	D_0	1.25
	D_1	1.35
	D_2	1.36
	D_3	1.32
Times of application		
	T_0	1.34
	T_1	1.26
	T_2	1.36
General Mean		1.32

Table 31 : Protein percentage in grain as affected by treatments.

Treatments		Protein percentage
Weedicides		
	S	8.12
	A	8.37
Concentrations		
	D_0	7.81
	D_1	8.44
	D_2	8.50
	D_3	8.25
Times of application		
	T_0	8.37
	T_1	7.87
	T_2	8.50
General Mean		8.25

Table 31 shows that the mean percentage of protein in the grain was 8.25.

Effect of weedicides :

Atrazine was found to increase the protein percentage in the maize grain than simazine.

Effect of concentrations :

The concentration of weedicides namely 2.0 kg a.i. per hectare increased the protein percentage in grain over those of the control, 1.0 and 3.0 kg a.i. per hectare.

Effect of times of application :

Among the various timesof application protein percentage in grain was increased with pre plus post emergence than that with pre and post emergence individually.

7. Nitrogen, P_2O_5 and K_2O contents of soil :

Data pertaining to mean percentage of total nitrogen, available P_2O_5 and K_2O in the soil at harvest as affected by various treatments are presented in Table 32. Data were not processed statistically. Inferences are drawn from the mean values.

It is seen from Table 32 that the mean percentage of total nitrogen, available P_2O_5 and K_2O in the soil at harvest were 0.0795, 0.0027 and 0.071 respectively.

7:1 Total nitrogen in the soil :

Effect of weedicides :

Weedicides had no much marked influence on the total nitrogen percentage of the soil.

Table 32 : Percentage of total nitrogen, available P_2O_5 and available K_2O in the soil as affected by treatments at harvest.

Treatments	Total nitrogen	Available P_2O_5	Available K_2O
Weedicides			
S	0.0798	0.0028	0.072
A	0.0792	0.0026	0.070
Concentrations			
D_0	0.0399	0.0024	0.064
D_1	0.1003	0.0028	0.073
D_2	0.0812	0.0027	0.072
D_3	0.1022	0.0029	0.075
Time of application			
T_0	0.0833	0.0029	0.070
T_1	0.0890	0.0028	0.072
T_2	0.0483	0.0025	0.071
General Mean	0.0795	0.0027	0.071

Effect of concentrations :

Concentrations of 1.0 kg and 3.0 kg a.i. per hectare had higher total nitrogen percentage over the control and 2.0 kg a.i. per hectare.

Effect of times of application :

Post emergence had higher total nitrogen percentage in the soil than that with pre and pre plus post emergence.

7:2. Available P_2O_5 in soil :

Effect of weedicides :

Simazine treated plots had higher available P_2O_5 in the soil over those treated with atrazine.

Effect of concentrations :

The available P_2O_5 content of the soil widely differed among concentrations of weedicides. In general, concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare had higher percentage of available P_2O_5 over the control.

Effect of times of application :

Pre emergence treatment was found to increase the percentage of available P_2O_5 in the soil than that of post and pre plus post emergence.

7:3. Available K_2O in soil :

Effect of weedicides :

Simazine treated plots had higher available K_2O in the soil over those treated with atrazine.

Effect of concentrations :

The concentrations of weedicides widely differed in the available K_2O content of the soil. However, the concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare had showed higher percentage of available K_2O than that in the control.

Table 33 : Economics of treatments

Treatments	Treatment cost Rs./ha	Total cost value Rs./ha.	Crop value minus treatment cost Rs./ha.	Additional profit over control Rs./ha.
Weedicides				
S	1223.00	3753.40	2530.40	- 68.20
A	1223.00	4062.76	2839.76	+ 241.16
Concentrations				
D_0	1025.00	3623.60	2598.60	-
D_1	1169.00	3922.50	2753.50	+ 154.90
D_2	1289.00	4265.10	2976.10	+ 377.50
D_3	1409.00	3832.40	2423.40	- 175.20
Time of application				
T_0	1049.00	3989.90	2940.90	+ 342.30
T_1	1049.00	3847.20	2798.20	+ 199.60
T_2	1073.00	3894.00	2821.00	+ 222.40

Labour required for spraying herbicides per ha = 8

Labour wages per day Woman Labour Rs. 2.50

Man Labour Rs. 3.50

Cost of simazine (Tafazine 50 per cent W.P.) Rs.60.00 per kg.

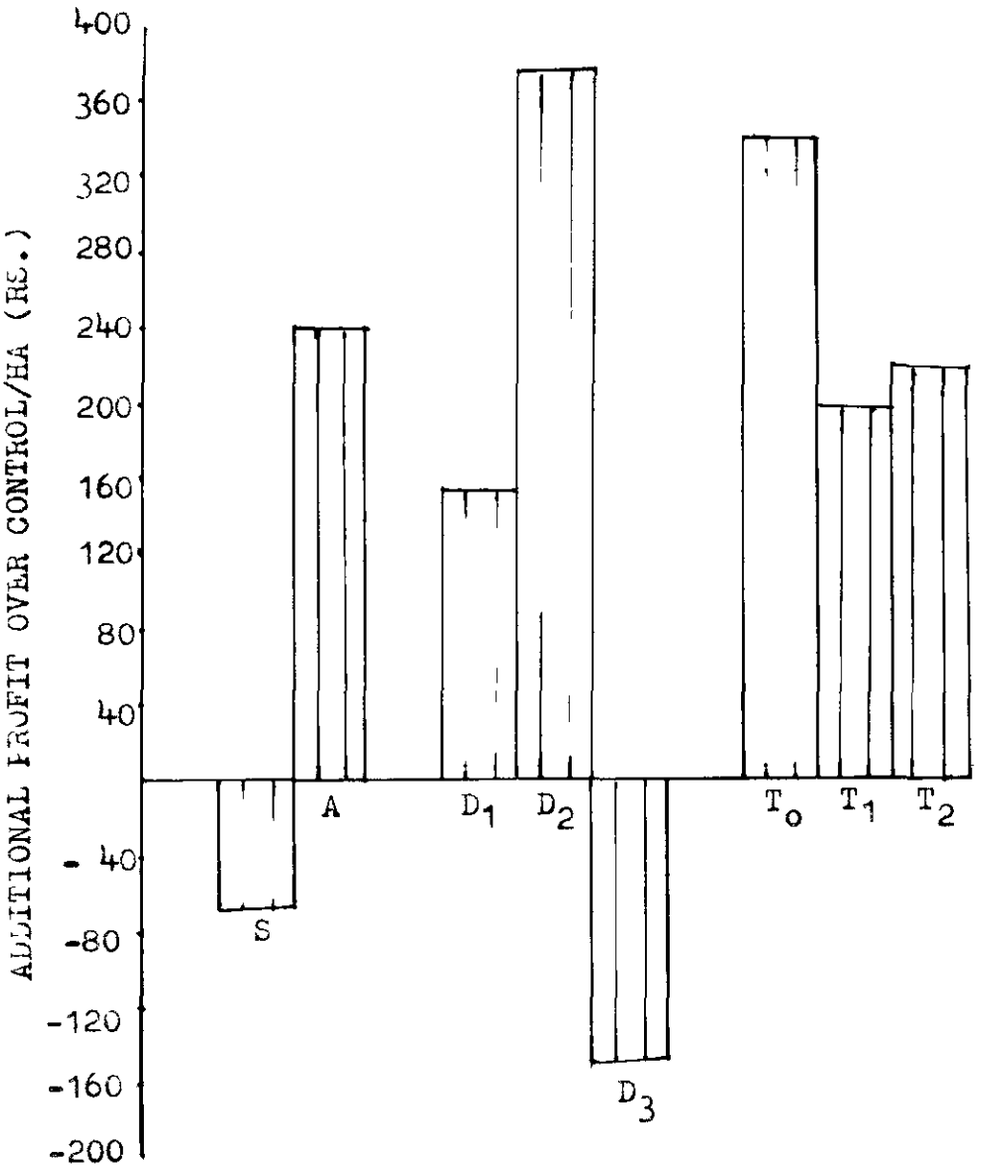
Cost of atrazine (Atrataf 50 per cent W.P.) Rs.60.00 per kg.

Price of maize grain Rs.80.00 per q.

Price of Karbi Rs.10.00 per q.

FIG.5

ECONOMICS OF TREATMENTS



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CHAPTER V

DISCUSSION

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CHAPTER V

DISCUSSION

The results of the present investigation, reported in the previous chapter, are discussed in this chapter.

1. Soil, Weather and Crop development :

The soil analysis carried out before sowing of maize clearly shows (in Table 1) that soilwas clayey in texture, calcareous in nature with high water holding capacity and tended to be alkaline in reaction. It was medium in nitrogen and available P_2O_5 status, rich in available K_2O, well drained and suitable of growing maize.

As regards weather conditions, from the data presented in Table 2, it would be seen that the rainfall at the commencement of Monsoon in July was sufficient for sowing, germination and satisfactory for the initial growth of maize. But subsequently from the 2nd fortnight of July to middle of August, the rainfall was inadequate for maize growth and also for the weed flora. Hence weed population was comparatively poor. Due to this, competition between weeds and maize was not very severe. The requirement of soil moisture for maize crop was made good by giving two protective irrigations.

The temperature prevailing during the sowing time and the crop growth period were favourable. The mean minimum and maximum temperatures ranged between 27.8°C and 35.5°C respectively. The humidity was very high during the crop season.

In general, temperature and humidity were favourable for the growth of maize, but rainfall after sowing was inadequate for weed growth and also for herbicidal action.

In order to bring out clearly the effect of season on the nature of growth of maize hybrid Deccan Double , under the soil and climatic conditions of Poona, an extract of relevant information on the important characters are presented in Table 34.

Data in Table 34 would show that the maize plant had attained the mean maximum height of 198.85 cm . The AGR of height was the maximum being 47.15 cm during 45 to 60 days. It had borne 14.35 leaves with total leaf area of 55.75 sq dm. Such a plant produced mean maximum total dry matter of 276.10 gm in 90 days. The mean maximum AGR, RGR and NAR values of dry matter were 46.33 gm, 0.8904 gm/gm and 0.8614 gm/sq dm respectively.

Mean length of cob was 12.58 with 13.84 grain rows and 429.99 grains. Such a cob produced 81.93 gm of grains. The weight of husk and heart per cob was 20.98 and 19.34 gm respectively. Grain to cob ratio and thousand grain weight recorded were 0.80 and 239.93 gm respectively. Under field conditions such a plant was capable of producing 8.74 and 14.53 kg of grain and fodder yield respectively. On hectare basis the corresponding figures worked out to be 40.47 and 67.27 quintals.

Table 34 : Influence of season on the growth attributes, yield contributory characters, weed flora, quality and yield of maize.

Sr. No.	Particulars	Mean maximum values
	Growth Characters	
1	Plant height (cm)	198.85
2	Number of functional leaves per plant	14.35
3	Leaf area per plant (sq dm)	55.75
4	Leaf area index	2.48
5	Dry matter of (gm)	
	a) Leaves	64.73
	b) Stem	74.41
	c) Reproductive parts	136.96
	d) Total dry matter per plant	276.10
	Physiological growth functions	
1	AGR of height (cm) (45-60 days)	47.15
2	AGR of dry matter (gm)	46.33
3	RGR of dry matter (gm) (30-45 days)	0.8904
4	NAR of dry matter gm/sq dm (60-75 days)	0.8614
	Yield contributory characters	
1	Number of cobs per plant	1
2	Length of cob (cm)	12.58
3	Number of grain rows per cob	13.84

Table 34 (Continued)

Sr. No.	Particulars	Mean maximum values
4	Number of grains per cob	429.99
5	Yield of grains per plant (gm)	81.93
6	Weight of husk per cob (gm)	20.98
7	Weight of heart per cob (gm)	19.34
8	Weight of cobs per plot (kg)	10.90
9	Yield of grains per plot (kg)	8.74
10	Weight of heart per plot (kg)	2.14
11	Yield of fodder per plot (kg)	14.53
12	Grain : cob ratio	0.80
13	Thousand grain weight (gm)	239.93
	Weed studies	
1	Number of weeds (1 m^2)	43.70
	a) after pre emergence spray (15 days)	
	b) after post emergence spray (30 days)	28.75
2	Air dry weight of weeds per plot(kg)	7.20
3	Weed Index (percentage)	17.79
	Chemical studies	
1	Nutrients removed by weeds per hectare in kg	
	a) Nitrogen	63.90

Table 34 (Continued)

Sr. No.	Particulars	Mean maximum values
	b) P_2O_5	38.45
	c) K_2O	67.84
2	Soil moisture percentage at harvest	11.19
3	Nutrient content of soil	
	a) Nitrogen	0.0795
	b) Available P_2O_5	0.0027
	c) Available K_2O	0.071
4	Nitrogen content of different plant parts.	
	a) Leaves	1.051
	b) Stem	0.557
	c) Reproductive part	0.643
5	Nitrogen percentage in grain	1.32
6	Protein percentage in grain	8.25

Studies on weeds brought out that mean number of weeds per plot counted at 15 and 30 days of sowing was 43.70 and 28.75 respectively. This resulted in producing 7.20 kg of air dry weight of weeds per plot at 95 days. The weed index was 17.79 when the cleanest plot was compared with the control. Weeds removed on an average N, P and K to the tune of 63.90, 38.45 and 67.84 kg per hectare respectively. Soil moisture percentage at harvest was 11.19. Plant analysis showed that the nitrogen percentage in leaves, stem and reproductive parts was 1.051, 0.557, 0.643, respectively. Nutrient status of the soil after cropping showed that total nitrogen, available P_2O_5 and K_2O in the soil after harvest were 0.0795, 0.0027 and 0.071 respectively. It was lower than the initial fertility status of the soil. The maize grain on an average contained 8.25 per cent of total proteins.

The present investigation has shown that germination percentage was not affected significantly by the weedicides, their concentrations and times of application, indicating thereby that the weedicides, their levels and concentrations were not detrimental for germination of maize.

Plant number per net plot recorded at harvest was also not affected significantly by the weedicides, their concentrations and times of application. However, the control plots resulted in reducing plant population over other treatment combinations. The available weed intensity seemed to have

suppressed the growth of some plants and made them difficult to survive.

1. Weedicides :

With a view to bring out the effects of simazine and atrazine on the growth ingredients, yield contributory characters, yield of maize and weed flora, an extract of relevant information is presented in Table 35.

Simazine and atrazine both were found to be effective in the control of weeds in maize when they were compared with control (Do). Between the two weedicides, atrazine was found to be more effective in the control of weeds and thus helped to enhance growth attributes and yield contributery characters of maize as compared to those with simazine. In general, the height of plant, number of leaves, leaf area and dry matter of plant were found to be enhanced from plots which were sprayed with atrazine as compared to those which were sprayed with simazine. Beneficial effects of atrazine were also found on the control of weeds which were ultimately reflected in enhancing the height of plant over simazine. Atrazine had increased the leaf number, leaf area, LAI, AGR of height, total dry matter per plant and RGR and NAR of dry matter (gm) per plant over simazine. It is well known that the triazine herbicides inhibit the photo-chemical activity. Moreland (1959) and Kmer (1961) also observed similar results. It was also proved that these herbicides inhibit photosynthesis in resistant species but CO_2 utilization by maize returns

to normal within a few weeds after treatment (Van Overbeek and Blakeman, 1961). In the present investigation, early growth of maize plants treated with simazine and atrazine was stunted, but afterwards normalcy was regained.

Between the two triazine compounds, atrazine in general, was more effective in producing higher dry matter of leaves, stem and reproductive parts throughout the growth period of maize while in simazine treated plots the height, leaf number, leaf area per plant and LAI were low due to competition set-in by the weeds left unaffected mainly for nutrition and soil moisture which ultimately seemed to have affected the dry matter accumulation, adversely.This resulted in accumulation of only 269.71 gm of total dry matter per plant in simazine treated plots, as against 282.48 gm in atrazine treated plots. Atrazine treated plot increased the total dry matter by 5.8 per cent over simazine.

Another interesting feature of data was that application of atrazine had favourably affected the height, leaf number, leaf area and LAI, AGR of height, RGR and NAR of dry matter in maize with the result that the growth characters of atrazine treated plots gave higher values of both grain and fodder per plant and per plot over simazine. In turn simazine also checked naturally occurring weed growth and was effective over the control.

Table 35 : An extract of relevant information giving effects of weedicides on growth, yield contributory characters, weed flora, quality and yield of maize.

Sr. No.	Particulars	Treatments	
		Simazine	Atrazine
1	Mean height of plant (cm) (90 days)	195.52	202.19
2	Number of functional leaves (75 days)	13.01	13.21
3	Leaf area per plant in sq dm (75 days)	53.22	58.28
4	Leaf area index (75 days)	2.37	2.59
5	Dry matter of (in gm)		
	a) Leaves(90 days)	63.64	65.81
	b) Stem (90 days)	73.94	74.88
	c) Reproductive parts (90 days)	132.13	141.79
	d) Total dry matter per plant	269.71	282.48
	Physiological growth functions		
1	AGR of height (cm) (45-60 days)	44.28	50.02
2	AGR of dry matter (gm) (60-75 days)	46.65	46.01
3	RGR of dry matter (gm/gm) (45-60 days)	0.5411	0.5637
4	NAR of dry matter gm/sq dm (60-75 days)	0.9115	0.8112

Table 35 (Continued)

Sr. No.	Particulars	Treatments	
		Simazine	Atrazine
	Yield contributory characters		
1	Number of cobs per plant	1.0	1.0
2	Length of cob (cm)	12.50	12.66
3	Number of grain rows per cob	13.60	14.08
4	Number of grains per cob	402.7	439.01
5	Number of grains per plant (gm)	79.69	84.17
6	Weight of husk per cob (gm)	20.69	21.27
7	Weight of heart per cob (gm)	17.97	20.71
8	Weight of cobs per plot (kg)	10.66	11.13
9	Yield of grains per plot (kg)	8.44	9.05
10	Weight of heart per plot (kg)	2.23	2.08
11	Yield of fodder per plot (kg)	13.56	15.50
12	Grain : cob ratio	0.79	0.81
13	Thousand grain weight (gm)	237.66	242.19
	Weed studies		
1	Number of weeds (ons sq m)		
	a) after pre emergence spray (15 days)	52.16	35.25
	b) after post emergence spray (30th days)	33.86	23.63

Table 35 (Continued)

Sr. No.	Particulars	Treatments	
		Simazine	Atrazine
2	Air dry weight of weeds per plot (kg)	7.72	6.69
3	Weed Index (percentage)	13.05	5.42
	Chemical studies		
1	Nutrients removed by weeds per hectare in kg		
	a) Nitrogen	67.38	60.42
	b) P_2O_5	41.78	34.12
	c) K_2O	71.47	64.21
2	Soil moisture percentage at harvest	11.23	11.16

The better growth also brought about improvement in yield contributory characters namely length of cob, number of grain rows per cob, number of grains per cob, weight per cob, weight of cobs per plot and finally yield of grain per plant. Length of cob was increased with atrazine treated plots over that with simazine. The number of grain rows per cob was also found to be increased with atrazine than that with simazine. The weight of cobs per plot was also higher with atrazine as compared to that with simazine. The better development of yield contributory characters with atrazine treated plots helped the maize plant to produce 84.17 gm of grain per plant, while it was 79.69 gm per plant with simazine. One of the additional ingredients which helped to enhance grain yield of atrazine treated plots over simazine was thousand grain weight. It was higher in the former than that in the latter. Another important factor which seems to have operated in favour of atrazine treatment is grain to cob rati It was higher in atrazine (0.81) than that in simazine (0.79) The over all effect on the economic produce was that the yiel per plot with atrazine was 9.05 kg while that with simazine was 8.44 kg . The corresponding weights of weeds obtained at the end of crop season were 6.69 and 7.72 kg per plot, indicating the cause for variations in grain yield per plot. It clearly showed the magnitude of losses caused by weeds prevai ing in these treatments. They were 13.05 and 5.42 per cent

with simazine and atrazine respectively. It is also evident from these observations that 13.05 per cent additional weeds in simazine treated plot had resulted in reducing the grain yield by 6.7 per cent as compared to those with atrazine.

Studies regarding the weed intensity per plot have shown that at both stages of weed count namely after pre emergence treatment (15 days after sowing) and after post emergence treatment (30 days after sowing), the number of weeds was more in simazine treated plots than that in atrazine treated plots. Thus atrazine as a overall was more effective in the control of weeds which ultimately resulted in bringing about better crop growth, enhanced yield contributory characters and finally increased of grain and fodder yields. The study on the weed index, based on the comparisons of yields obtained in atrazine treatment with that of simazine clearly indicated the relative efficacy of weedicides. The weed index for atrazine was 5.42 while for simazine it was 13.05. It shows that in simazine treated plots the reduction in yield due to presence of weeds was greater than that with atrazine indicating more scope for weed control in the former than that in the latter.

Chemical studies regarding the removal of N, P and K by weeds in simazine and atrazine treated plots had shown that atrazine treatment on an average removed the N, P and K by weeds per hectare to be 60.42, 34.12 and 64.21 kg while

that with simazine they were 67.38, 41.78 and 71.47 kg per hectare respectively. It is clear from these data that N,P and K removed by weeds were lesser in atrazine treated plots than those with simazine application largely because of more effective control of weeds by atrazine than that with simazine. This shows that weeds removed huge quantities of nutrients which would have been otherwise used by the crop for better growth, so as to produce higher yield of grain and fodder.

Data on nitrogen percentage in different plant parts, in general, showed that in leaves, stem and reproductive parts at the maximum growth period in atrazine treated plants, it was higher than those in simazine treated plants. Protein percentage in the grain was higher in case of atrazine than than in simazine treated plants. Regarding soil moisture studies no consistent trend was observed at harvest.

Studies regarding the economics of the treatment responses had shown that the per hectare additional profit with the use of atrazine over the control was Rs. 241.16.

Finally the results, in general, have shown that between the two triazine weedicides, atrazine was observed to be promising between the two.

2. Concentrations :

In order to bring out the effects of different concentrations on the growth and yield of maize and weed flora, an extract of relevant information is presented in Table 36.

It was revealed from the present investigation (Table 36) that the concentrations of weedicides, in general, affected the growth characters of maize in terms of height, number of leaves, leaf area and LAI as compared to that of the control where weeds were allowed to grow naturally. As a result of better weed control, the concentrations namely 1.0, 2.0 and 3.0 kg a.i. per hectare increased the dry matter per plant over that of the control. The plants subjected to higher doses of weedicides (3.0 kg a.i. per hectare) decreased the height, number lf leaves, leaf area, LAI and dry matter per plant as compared to lower doses of weedicides (1.0 and 2.0 kg a.i. per hectare). The other growth characters namely AGR of height and dry matter, RGR and NAR were also decreased under the plants subjected to higher doses of weedicides. This may be due to the slight phytotoxic effect of higher doses of triazine compounds which seem to have retarded growth characters in early stages and produced less taller

of cob, number of grain rows per cob, number of grains per cob, weight per cob, weight of grains per plot, weight of fodder per plot, grain to cob ratio and thousand grain weight. The grain yields with 0.0, 1.0, 2.0 and 3.0 kg a.i. per hectare concentrations were 8.10, 8.73, 9.54 and 8.60 kg per plot respectively. The concentration of 2.0 kg.a.i. per hectare increased the yield by 17.79, 9.28 and 10.92 per cent over those of the control, 1.0 and 3.0 kg a.i. per hectare of weedicide respectively. This is also supported by data on the number of weeds in unit area (one sq m) in various plots treated with 1.0, 2.0 and 3.0 kg a.i. per hectare before and after post emergence application of weedicide sprays. The concentrations of 1.0, 2.0 and 3.0 kg a.i. per hectare controlled the weeds by 51.63, 58.66 and 70.05 per cent over the control respectively. Weed index was the lowest with 2.0 kg a.i. per hectare which resulted in producing the maximum yield of grains per plant and also per plot over the control. Yield of fodder was also higher with 2.0 kg a.i. per hectare than the control, 1.0 and 3.0 kg a.i. per hectare concentrations.

Studies regarding the removal of N, P and K by weeds in different concentrations also resulted in differential responses. The concentration of 3.0 kg a.i. per hectare being more effective in the control of weeds, evidently resulted in removal of comparatively smaller quantities of N P K. The highest concentration of triazine herbicides tried had removed

57.14, 39.26 and 50.72 kg per hectare of N P K respectively. In comparison with this, the removal of N P K from unweeded control was very much higher and was 129.60, 63.27 and 131.13 respectively.

It is clear from Table 33 that nitrogen percentage in leaves was 0.994, 1.080, 1.079 and 1.064 per cent with 0.0, 1.0, 2.0 and 3.0 kg a.i. per hectare of weedicides respectively. The nitrogen percentage in stem and reproductive parts was improved in accordance with reduction in the extent of weed competition and the vigour of the crop. Protein percentage in grain was found to be increased with 2.0 kg a.i. per hectare over the control and slightly over 1.0 and 3.0 kg a.i. per hectare.

Studies regarding the economics of different concentrations had shown that per hectare additional profit with 1.0, 2.0 and 3.0 kg a.i. per hectare was Rs. 154.90, Rs.377.50, and Rs. 175.20 respectively over the unweeded control. This showed that concentration of 2.0 kg a.i. per hectare produced higher additional profit than in those treated with 1.0 and 3.0 kg a.i. per hectare. With the latter, there was a loss to the tune of Rs. 175.20 per hectare.

3. Times of Application :

Data regarding the times of application of weedicides showed that the pre emergence and pre plus post emergence times of application were found to be more effective than post

emergence application. There was no much difference between pre and pre plus post emergence application regarding number of weeds per sq m as well as dry weight per plot. However, weight of weeds obtained in the former was higher than those of latter times of application namely pre or post emergence application. Weed number, 15 days after sowing was less in plots treated with the pre and pre plus post emergence times of application. In the latter it was largely due to pre emergence application. Weed weight was slightly higher in the post emergence treatment. This may be due to profuse growth of weeds after 30 days onward. The growth of weed flora was not satisfactory. It may be due to inadequate soil moisture after 30 days of sowing.

The weeds weight obtained with pre, post and pre plus post emergence times of application were 6.95, 7.87, 6.79 kg per plot respectively. This showed pre plus post emergence application controlled the weeds more effectively.

Ultimately because of effective weed control, both the growth characters and yield contributory ingredients had higher values for pre and pre plus post emergence treatment as compared post emergence application. In pre emergence treatments, application was made with whole quantity of weedicide after 2 days of sowing, while for pre plus post emergence half the quantity of weedicide as pre emergence was made 2 days after sowing and half quantity as post emergence after 23 days of sowing. Pre emergence application of weedicide

eliminated the weeds in early growth stage of crop which is the most important stage of maize growth when the plants were least resistant to adverse conditions. Maize is known to be very sensitive to weed competition at the early stage and methods of control of weeds by pre plus post emergence time of application seemed to be better following by pre emergence application than that of post emergence.

The post emergence application of weedicides was made 23 days after sowing, when maize crop was 15 cm in height. Pre emergence application of weedicide had controlled the weeds in early growth stage of maize and weeds, thereby reducing the number of weeds and finally their weight also. While the post emergence application of weedicide was less effective in reducing the weed number and their weight at harvest. This was probably because the post emergence application could not prove more effective, probably because the weeds passed the stage of susceptibility when the post emergence application was made.

Pre emergence application of weedicide was found to kill the weeds namely Acalypha indica, Euphorbia sp., Convolvulus arvensis, Amaranthus polygamus, Commelina benghalensis. While the post emergence application of weedicide was found to be effective in controlling Celosia argentia, Acalypha indica, Euphorbia sp. and Saccharum spontaneum. However, the weeds like Cynodon dactylon, Cyperus rotundus, Parthenium hysterophorus, Eschaemum pilosum were not affected

much either by pre emergence or post emergence application or even by both.

It is noted from Table 33 that N, P and K removed by weeds were lesser in the pre and pre plus post emergence application than those in post emergence application. In pre emergence treatment N and P removed by weeds were lesser than those with pre plus post emergence treatment. N, P and K removed through weeds by post emergence application were much higher than the rest. It has been observed that plants treated with pre emergence application, in general, had observed more percentage of nitrogen in different plant parts than those in the post and pre plus post emergence application.

The studies regarding economics of treatments indicated that pre emergence application had resulted in yielding more additional profit over pre plus post emergence and post emergence application.

Finally, it may be stated, on the basis of results reported in the previous chapter and discussed here-to-fore in this chapter, that atrazine was better than simazine. It should be applied as pre emergence sprays with 2.0 kg a.i. per hectare.

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CHAPTER VI

SUMMARY

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SUMMARY

An investigation to study the relative efficacy of varying levels of simazine and atrazine applied as pre, post and pre plus post emergence sprays on growth and yield of maize (Zea mays Linn.) hybrid Deccan Double and weed flora, was carried out in the Division of Agronomy, College of Agriculture, Poona-5 during Kharif 1972 by laying out a field experiment.

In this study twenty four treatments comprising of two weedicides namely simazine and atrazine, four concentrations namely 0.0, 1.0, 2.0 and 3.0 kg a.i. per hectare and three times of application, namely pre, post and pre plus post emergence sprays were included. It was laid out in a factorial randomised block design with three replications. The gross and net plot sizes were 7.50 x 4.80 m^2 and 6.00 x 3.60 m^2 respectively. The findings emerging from this investigation are as under :-

a) Germination percentage :

The various factors under study did not affect the mean germination percentage of maize hybrid Deccan Double.

b) Plant population :

The final plant population at harvest was also not influenced by weedicides, their concentrations and times of application.

e) Weedicides :

Growth characters namely the height of plant, number of functional leaves and total dry matter per plant; physiological growth functions namely, AGR, RGR and NAR of dry matter were found to be increased by the application of atrazine over those of simazine. Beneficial effect of growth characters resulted in enhancing yield contributory characters, namely, length of cob, number of grain rows per cob, number of grains per cob and yield of grains per cob by the former over the latter. The grain to cob ratio and thousand grain weight were also higher with atrazine than those with simazine. The weight of cobs, yield of grain and fodder per plot were also enhanced by the application of atrazine over those by simazine.

Weed studies showed that weed number per plot and the air dry weight of weeds at harvest were found to be lower in atrazine than those in simazine treated plots indicating the efficiency of atrazine in killing weeds over simazine. The weed index was also high with simazine than that with atrazine, suggesting that there was more scope for further weed control in this treatment. Evidently the quantities of nutrients removed namely, N, P and K by weeds per hectare were higher in simazine treated plots than those with atrazine. This was due to higher weight of weeds in the former than that in the latter. The nitrogen percentage in stem and reproductive parts of simazine treated plants was found to be higher than those with atrazine. While nitrogen percentage in leaves and grain

was higher with atrazine than those with simazine. The protein percentage in grain was higher with atrazine than that with simazine.

Atrazine was found to controlled the weeds effectively namely Acalypha indica, Celosia argentia, Euphorbia sp., Convolvulus arvensis, Commelina benghalensis, Amaranthus polygonum. While weeds like Cynodon dactylon, Cyperus rotundus, were not affected much by any of their concentrations.

Studies on economics of use of weedicides has revealed that additional returns accrued by the used of atrazine was Rs. 241.16 per hectare over the control, while with simazine there was a loss which indicates the superiority of atrazine over simazine.

d) Concentrations :

The concentration of 2.0 and 3.0 kg a.i. per hectare had resulted in reducing the weed population more effectively than those of 0.0 and 1.0 kg a.i. per hectare. The efficiency of weedicides in reduction of weeds was increased with increase in the concentration. Favourable effects obtained due to reduction of weed densities and eliminating weed competition with higher concentrations of 2.0 and 3.0 kg a.i. per hectare seemed to have enhanced both the growth and yield contributory characters, making more favourable conditions for growth of crop. However, weed population, in general, was comparatively poor during the year under report due to inadequate rainfall.

The yield per plant and per plot of grain and fodder were increased with 2.0 kg a.i. per hectare over that of 0.0, 1.0 and 3.0 kg a.i. per hectare. Among the 0.0, 1.0 and 3.0 kg a.i. per hectare it was higher in the latter two than in the former. On av average 8.10, 8.73, 9.54 and 8.60 kg of grain yield per plot was recorded with 0.00 (control) 1.0, 2.0 and 3.0 kg a.i. per hectare respectively. Corresponding figures for fodder yield were 13.47, 14.88, 15.80 and 13.97. It was higher in 2.0 kg a.i. per hectare than the rest of the concentrations.

Chemical studies showed that nitrogen percentage in leaves and protein percentage in grains were higher with 1.0 and 2.0 kg a.i. per hectare. While nitrogen percentage in the stem and reproductive parts was increased with higher concentrations. The N, P and K removed by weeds were decreased with increase in the concentrations. Weed densities, air dry weight of weeds and weed indices were found to decrease with higher concentration of weedicides particularly 2.0 kg a.i. per hectare. Additional profit over the control obtained with 1.0, 2.0 and 3.0 kg a.i. per hectare was Rs. 194.90, Rs.377.50 and Rs.-175.20 per hectare respectively. This shows that the concentration of 2.0 kg a.i. per hectare of weedicide was effective and economical too.

e) Times of application :

Results on times of application of weedicides showed that pre plus post emergence and pre emergence application of

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