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RESEARCH ARTICLE Indian Journal of Agricultural Research, Volume Issue : ()

Effect of Integrated Weed Management Practices on Weed Dynamics and Performance of Maize Crop

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10.18805/IJARe.A-5877

ABSTRACT

Background: Maize is the third most important cereal in India after rice and wheat which contributes nearly 9% in national food basket. Weed infestation is a major problem in maize, primarily at initial growth stages and due to wider spacing, hence weed control is essential to reduce the competition with maize crop. In maize row to row spacing is more so maximum number of weeds appears and compete with main crop.

Methods: A field experiment was conducted in the University Agricultural Farm under the Department of Agronomy in *kharif* 2019. The soil of the experimental field was sandy loam in texture having pH 6.87 and electrical conductivity 0.32 mmhos/cm. The experiment was comprised of eight treatments and laid out in randomized block design with three replications T_0 (Control), T_1 (Hand weeding at 20 DAS, 40 DAS), T_2 (Atrazine 1 kg/ha after 3 days of sowing), T_3 (Metribuzin 1 kg/ha after 3 days of sowing), T_4 (Alachlor 1.5 kg/ha after 3 days of sowing), T_5 (Atrazine + hand weeding 1 kg/ha (after 3 days and 30 days after sowing), T_6 (Metribuzin + hand weeding 1 kg/ha (after 3 days and 30 days after sowing), T_7 (Alachlor + hand weeding 1.5 kg/ha (after 3 days and 30 days after sowing). The texture of the experimental field soil was sandy loam having pH-6.87, EC-0.32 mmhos/cm.

Result: The weed species recorded at the experimental site were mainly comprised with grasses, sedges and broadleaf weeds. The dominant weed species infested in the experimental field were: *Cynodon dactylon* (doob grass), *Cyperus rotundus, Amaranthus viridis, Anagallis arvensis, Argemone mexicana, Chenopodium album, Parthenium hysterophorus* and *Trianthema prolacastrum.* Significant reduction in the weed density was recorded in manual weeding. The highest plant height, stem girth, number of leaves, flag leaf length, chlorophyll content, leaf area index, grain yield and stover yield was recorded highest with hand weeding which was followed by T7 (Alachlor + hand weeding 1.5 kg/ha (after 3 days and 30 days after sowing).

Key words: Flag leaf length, Grasses, Pre emergence herbicides, Sedges, Weed flora.

INTRODUCTION

Maize is the third most important cereal in India after rice and wheat which contributes nearly 9% in national food basket. It is cultivated throughout the world. The maize crop cultivated in over the world with 193.7 million hectares of area and around 1147.7 million tonnes in production. In India, the production of maize is around 27.8 million MT from an area of around 9.2 million hectares in 2018-2019. More than half of the maize in India is produced in four states of Madhya Pradesh andhra Pradesh, Karnataka and Rajasthan. The low productivity of maize in India as compared to maize growing countries of the world can be attributed to several limiting factor of which poor weed management which poses a major threat to crop productivity (Hossain *et al.,* 2019). The losses in yield due to weed emergence vary from 28-93% depending on weed flora type, their intensity, stage, nature and duration of crop weed competition (Reddy 2018). Maize is generally infested by a wide range of weed flora, *viz. Echinochloa colonum, Cyperus rotundus, Commelina benghalensis* and *Trianthema portulacastrum* dominate during early stages of the crop growth whereas *Dactyloctenium aegyptium* toward the tasselling and maturity phase of the crop (Ariraman *et al.,* 2020). To get maximum production of maize, weed management is compulsory. During early growth stages of maize due to continuous rainfall there was too much moisture in the field, hence cultural and mechanical methods of weed control are not possible. Therefore, pre-emergence herbicides and hand weeding is a better alternative weed management option for achieving high yield potential of maize (Kumar *et al.,* 2017). Therefore, to find out the best method for effective weed management in maize and the study was initiated to assess the efficiency of weed management practices on maize crop

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How to cite this article: Singh, A., Sarkar, S., Bishnoi, U., Kundu, T., Nanda, R., Robertson, A. and Mor, M. (2021). Effect of Integrated Weed Management Practices on Weed Dynamics and Performance of Maize Crop. Indian Journal of Agricultural Research. DOI: 10.18805/IJARe.A-5877.

Submitted: 13-07-2021 **Accepted:** 01-09-2021 **Online:** 14-10-2021

MATERIALS AND METHODS

The experiment was conducted in the university agricultural farm under the department of agronomy in *kharif* 2019. The

soil of the experimental field was sandy loam in texture having pH6.87 and electrical conductivity 0.32mmhos/cm, medium available nitrogen (313 kg/ha), medium phosphorus (22 kg /ha) and potassium (112kg /ha). The selected design was used randomized block design and total treatments was 8 with three repetitive. The detail of used treatments is T_0 control, T_1 Hand Weeding, T_2 Atrazine, T_3 Metribuzin, T_4 Alachlor, T_5 Atrazine + hand weeding, T_6 Metribuzin + hand weeding, T_7 Alachlor + hand weeding. The rate of recommended dose of nutrients is 120 kg N, 60 kg P_2O_5 and 60 kg K_2O was supplied through its sources like Urea, SSP and MOP, respectively.

Experimental details:

S. no.	Treatment's detail
T_0	Control
T_1	Hand weeding at 20 DAS, 40 DAS.
T_2	Atrazine 1 kg/ha after 3 days of sowing.
T_3	Metribuzin 1 kg/ha after 3 days of sowing.
T_4	Alachlor 1.5 kg/ha after 3 days of sowing.
T_5	Atrazine + hand weeding 1 kg/ha (after 3 days and 30 days after sowing).
T_6	Metribuzin + hand weeding 1 kg/ha (after 3 days and 30 days after sowing).
T_7	Alachlor + hand weeding 1.5 kg/ha (after 3 days and 30 days after sowing).

Weed flora and density

Density of different weeds in each plot was studied at 20 and 40 DAS. With the help of quadrate, measuring 1m^2 was placed in specified treatment in net plot area. Weeds within the quadrate were counted and weed flora was studied and classified into three categories *viz*: grasses, broad leaves and sedges. The observation was computed to give weed density (number/m^2) and subjected to square root of transformation *i.e.*, $\sqrt{X + 0.5}$ prior to statistical analysis for test of significance.

Dry weight and wet weight analysis

Weed samples taken for weed density at 20 and 40 days after sowing were dried in hot air oven 60°C (± 5°C) remove moisture present on the surface of weeds. Dry weight was recorded on electronic balance and converted into g/m^2.

Leaf area index

Periodic leaf area index at 20, 40 days after sowing were recorded. Leaves of single plant (cut for dry matter) were separated manually. An area measuring 10 cm long × 3 cm wide was cut out from upper, middle and lower portion of each leaf. Then LAI was calculated using the following formula:

$$\text{Leaf area index} = \frac{\text{Leaf area}}{\text{Ground area}}$$

Plant height

It is the measurement of the total length of a plant from the base to the tip of the highest leaf or flag leaf. The maximum plant height was recorded in T_1 where Hand weeding at 20 DAS, 40 DAS was used followed by T_7 (Alachlor + hand weeding 1.5 kg/ha (after 3 days and 30 days after sowing). There was not any herbicide effect was recorded on the tip of the plants. As result there was no tip burning and height of the plants was regularly increased without any harness.

Leaf length and leaf width

It is recorded by measuring the length of the longest leaf or flag leaf of the plant from the base to the tip. The maximum leaf length was recorded in T_2 (Atrazine 1 kg/ha after 3 days of sowing) because of atrazine is from triazine class. It is very much effective to prevent the pre-emergence broadleaf weeds. Due to the absence of weeds, there was proper space for the increasing the leaf length, but leaf width has been height recorded in T_1 (Hand weeding at 20 DAS, 40 DAS) due to the hand weeding, soil aeration was proper in the soil time to time. So, plant was properly flourished with good photosynthesis rates.

Stem girth

It is the measurement around the circumference of the stem near the base of the plant. The maximum stem girth was recorded in T_1 (Hand weeding at 20 DAS, 40 DAS), followed by T_6 (Metribuzin + hand weeding 1 kg/ha (after 3 days and 30 days after sowing), because of there was proper eradication of weeds with two different weeding practices like hand weeding and chemical combination.

RESULTS AND DISCUSSION

The weed species recorded at the experimental site were mainly comprised with grasses, sedges and broadleaf weeds. The dominant weed species infested in the experimental field were Grasses–*Echinochloa crusgalli* (Swank), *Echinochloa colonum* (Barnyard grass) and *Ischaemum rugosum* (Wrinkle grass). Sedges were *Cyperus iria, Cyperus rotundus* (Nut grass) and *Cyperus difformis* (Dila motha). Broadleaf weeds *Eclipta alba* (Jalbhang grass), *Eleocharis atropuea* (Ghueen), *Euphorbia hirta* (Dhodhak) and *Ludwigia axillaris* (Gharilla) (Kakade *et al.,* 2020) and Andert (2021). Significant reduction in the weed density was recorded in manual weeding. This practice helps in eradication of weeds. At crop harvest, hand weeding twice resulted in lower density of weeds which remained at par with Alachlor + hand weeding and T_5 (Atrazine + hand weeding 1 kg/ha after 3 days and 30 days after sowing). The highest weed density was observed in the control because there was no herbicide applied in the plot and no removal of weeds were done manually (Susha *et al.,* 2018). Therefore, weeds gave more competition to the maize plants. So, the weed density is more in the control plots. Weeds were removed manually in T_1 (Hand weeding at 20 DAS, 40 DAS), so the density of weeds is lesser as compared to T_0 (Control). Weed Biomass also recorded at 30 and 60 DAS (Soren *et al.,* 2018). Minimum weed biomass was recoded in T_1 (Hand weeding at 20 DAS, 40 DAS) which was at par

with T_7 (Alachlor + hand weeding 1.5 kg/ha after 3 days and 30 days after sowing). The plant height was recorded at different intervals. The highest plant height is observed in T_2 (Atrazine 1 kg/ha after 3 days of sowing) (94.6 cm) followed by T_7 (Alachlor + hand weeding 1.5 kg/ha after 3 days and 30 days after sowing) (88.2 cm) because there was no phytotoxic effect of the chemicals on the plants of maize. The lowest plant height was observed in T_0 (Control) (43 cm) Fig 1. Alachlor inhibited the germination of the weeds of the maize crop. The hand weeded plots showed more plant height as compared to the treatments in which herbicides were applied. The maximum stem girth was observed in the T_1 (Hand weeding at 20 DAS, 40 DAS), (4.8 cm) (Fig 6). The lowest stem girth was observed in the T_0 (Control) (2.7) because it inhibited the germination of maize plants (Imoloame (2020). Stem girth was almost similar for all the plots except control. The highest leaf length and width was observed in the T_1 (Hand weeding at 20 DAS, 40 DAS), (55.2 cm, 7.5 cm) because of no phytotoxic effect of the weedicides on it (Fig 2, 3). The lowest leaf length and width was observed in the T_0 (Control) (22.3 cm, 3.2) because it has inhibited the germination of the maize plants as well as weeds. The treatments having weedicide application have less leaf length as compared to the T_1 (Hand weeding at 20 DAS, 40 DAS) because there is some negative effect of the chemicals on the maize plant (Yadav *et al*., 2018). The highest leaf area index was observed in the T_1 (Hand weeding at 20 DAS, 40 DAS) (290.33 cm). The lowest leaf area index was observed in the T_0 (Control) (211.63) (Fig 4). The highest chlorophyll content was observed in the T_1 (Hand weeding at 20 DAS, 40 DAS), T_7 (Alachlor + hand weeding 1.5 kg/ha after 3 days and 30 days after sowing) (30.2 29.2SPAD). The lowest chlorophyll

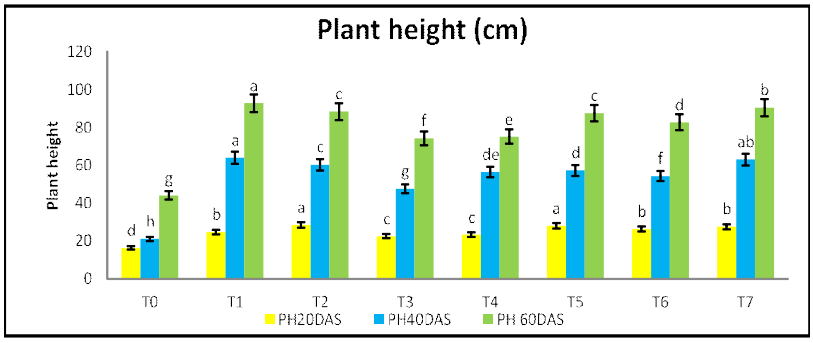

Fig 1: Plant height at 20, 40 and 60 days after sowing.

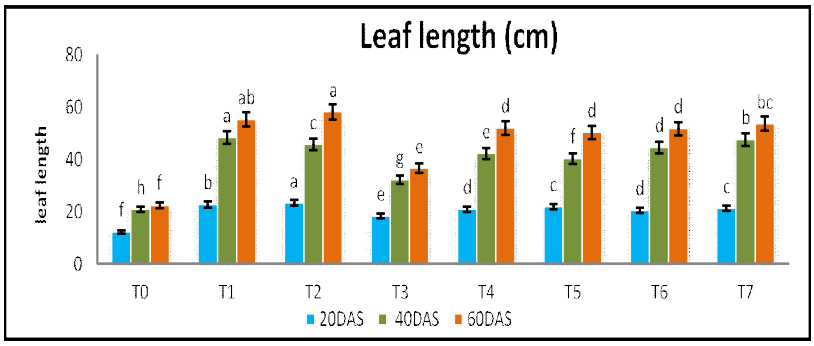

Fig 2: Leaf length at 20 days after sowing and 40 and 60 days after sowing.

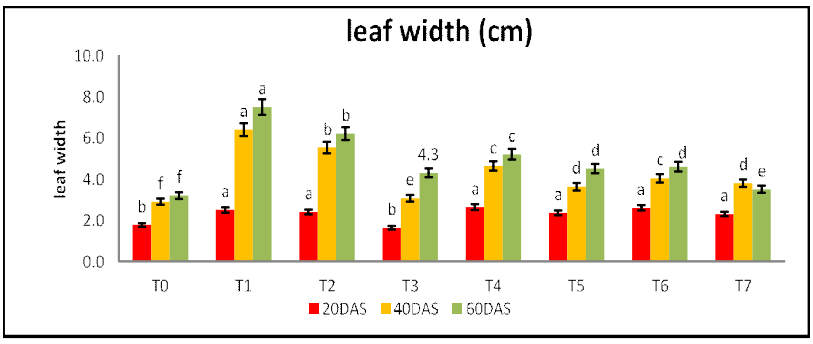

Fig 3: Leaf width at 20 days after sowing and 40 and 60 days after sowing.

content was observed in the T_0 (Control) (17.3) because of the negative impact on the growth of maize plants (Al Al Tawaha (2021). Hand weeding shows better results as compared to the control (Fig 5). The maximum weed density is present in T_0 where I have not used any weed control method, because the weeds are wild in nature and able to grow very quickly as compared to T_1 where I have used hand weeding at 30 and 60 DAS (Fig 7).

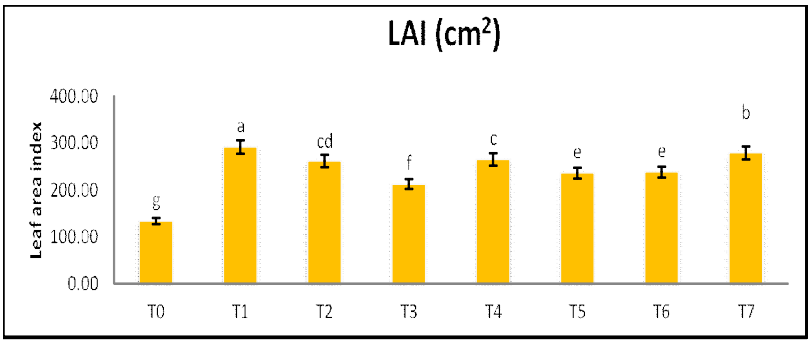

Fig 4: Leaf area index of maize plant.

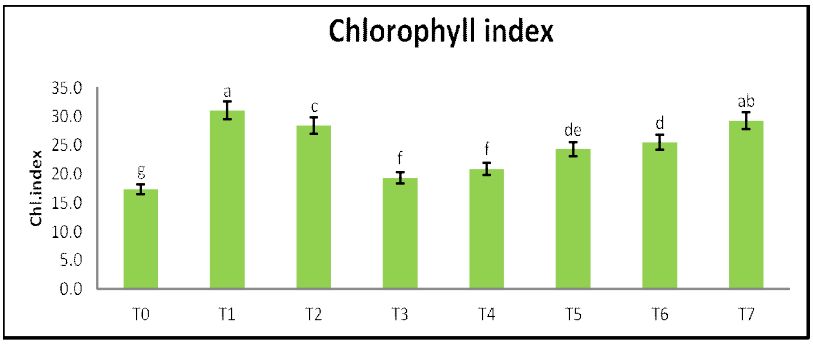

Fig 5: Chlorophyll index (SPAD) of maize plant.

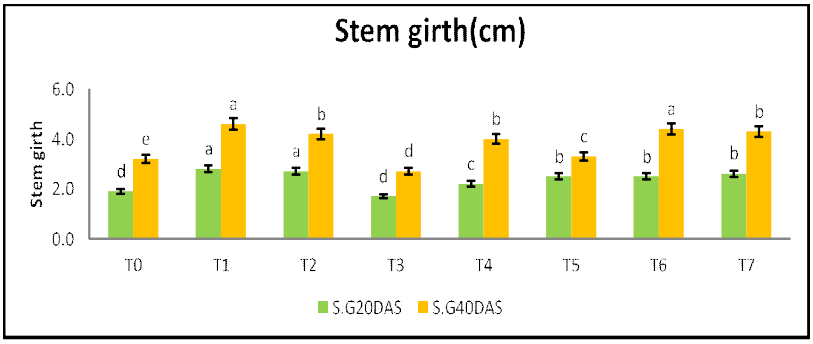

Fig 6: Stem girth at 20 days after sowing and 40 days after sowing.

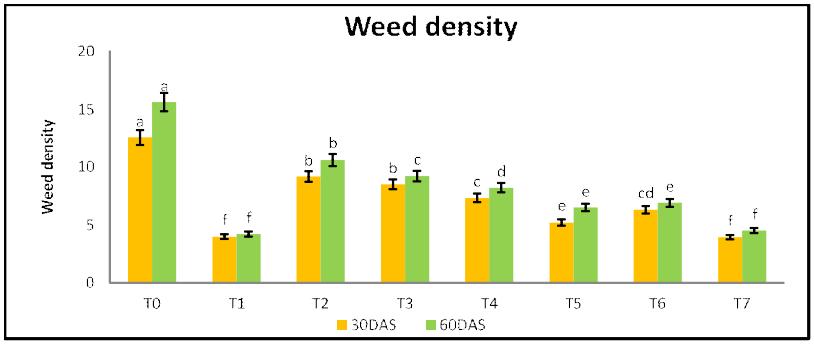

Fig 7: Weed density at 30 days after sowing and 60 days after sowing.

CONCLUSION

Chemicals are showing the great result to the farmers now in these days due their quick action in less time. So, many modes of actions are present in the chemicals to kill the any types of weeds like pre and post application of the herbicides, which are also toxic in nature. In this research there is no doubt that weed density recorded less in chemical application. But the best result was obtained by the hand weeding. For hand weeding more labours are required and it is time taking method also but with this method there was no phyto-toxic effect on the maize plant in hand weeding as comparison to the chemical application that is why the best growth of maize was recorded in that treatment and the remaining treatments showed phytotoxic effect on the maize plant up to some extent.

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