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## EFFECT OF INTEGRATED WEED MANAGEMENT IN MAIZE (*Zea mays* L.) UNDER IRRIGATED CONDITION

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**ABSTRACT**

Field experiments were conducted at ICAR Krishi Vigyan Kendra, Valikandapuram, Perambalur district of Tamil Nandu during kharif 2017 to study the response of maize hybrids to varied plant densities and weed control methods under irrigated condition. The experiments were laid out in split-plot design replicated three with five main treatments *viz*., $M_1$- Maize sole crop, $M_2$-Maize + blackgram, $M_3$-Maize + cowpea, $M_4$- Maize + soybean and sub plot treatments *viz*., $S_1$- Un weeded check, $S_2$-Hand weeding (Two times) 20 and 40 DAS, $S_3$-Alachlor @ 0.2 kg /ha as pre emergence + Twin wheel hoe on 30 DAS, $S_4$- Alachlor @ 0.2 kg /ha as pre emergence + one hand weeding on 30 DAS, $S_5$-Alachlor + Post emergence tembotrione on 21 DAS. From the results, it is concluded that maize + cowpea ($M_3$) along with $S_3$-Alachlor @ 0.2 kg /ha as pre emergence + Twin wheel hoe on 30 DAS was recorded the lower weed density and weed control efficiency and the highest growth parameters, yield parameters and yield and proved to be an efficient and economically feasible technology to manage the weeds and to realize better returns from the irrigated hybrid maize.

***Keywords*** : Maize, Inter cropping, LAI, DMI

## Introduction

By the year 2050, the world as we know today would change in many exciting ways. The world's population would exceed 9 billion and average global temperature would rise, and most importantly, the world would be running out of basic necessities like food, fodder and fuel (Shenggen Fan and Brzeska, 2010). Maize is one of the most important food crops in India and is increasingly gaining an important position in crop husbandry because of its higher yield potential and short crop duration. In India, maize is grown in an area of 8.78 m ha with a production of 21.76 m t. The average productivity of maize in India is about 2478 kg $ha^{-1}$ as against the world average of 4860 kg $ha^{-1}$ (Anon., 2013). It contributes a lot to the economy of the country, as it is a rich source of food and feed and also provides raw materials for the industry. About two-third of the total world production of maize is used for livestock feed or for commercial starch and oil production (Khalil and Jan, 2004). Now-a-days, the labour force is diminishing in agriculture. Management of weeds in cropped field has become a real challenge to the farmers. Weeding has traditionally been a labour intensive operation in crop production. Manual weeding is seldom possible, because of greater demand and high cost of human labour. Pre-emergence application of atrazine is the most beneficial one in maize weed control compared to other chemicals for broad spectrum weed control (Ramesh and Senthivel, 2019). The production and productivity of maize is reduced due to competition offered by weeds for growth resources *viz*., nutrients, moisture, sunlight and space during entire vegetative growth and early reproductive stages. They also transpire lot of valuable conserved moisture and absorb large quantities of nutrients from the soil. Manual weeding is a common practice, but it is less efficient, labour intensive, costly and often not done at proper stage. Mostly farmers adopt manual weeding only after sufficient weed growth. It is essential to remove the early flush of weeds at right time. For this, the pre-emergent herbicides come to the rescue of farmers by keeping the maize fields weed free in the first 30-35 days of crop growth. But farmers are unable to apply pre-emergent herbicides at time of sowing, since they give priority on completion of sowing. Moreover, there is acute shortage of labour even for sowing operation. Hence, there is need to use early post emergent herbicides, which can be conveniently applied after 15 to 20 days of sowing, that too when the pressure of completing the sowing is over. Weed management with early post-emergent herbicide may become a viable alternative to the current methods of weed control. Application of early post-emergent herbicides may involve one herbicide or may involve two herbicides. The problem with application of one herbicide is that it controls specific weed flora. For example atrazine is effective against broad leaf weeds, but tembotrione controls grassy weeds effectively. To have broad spectrum weed control, we may have to maize inter cropping with pulses s having effectiveness against different weed flora. Maize intercropping with pulses can become effective tools to enhance efficiency. The Various weed management practices reduced broad spectrum weed control; arrests weed shifts, reduces cost of weed management and prevents herbicide resistance in weed. A well planned maize inter cropping with pulses will provide more effective weed control and help to solve problems. This would help to have broad spectrum weed control, killing both broad leaves weeds and grassy weeds. Information on such maize inter cropping and pre-emergence with mechanical weeding is not available. Hence, intensive studies were needs to evolve on integrated weed management in Maize under irrigated condition.

## Materials and Methods

The experiments were laid out in B block of ICAR Krishi Vigyan Kendra Farm. The Experimental farm is located in Tamil Nadu between 10º 53' and 11º31' N latitude and 73º 38˙ and 79º 31˙ E longitude. The temperature ranges from 22 °C - 39 °C with mean annual rainfall of 908 mm. North East monsoon period receives comparatively more rainfall *i.e.* 475 mm followed by 314 mm during South West monsoon, 91 mm during summer and 28 mm during winter season. The experiment was conducted in Spit plot Design. The main plots comprised of four treatments *viz.*, $M_1$- Maize sole crop, $M_2$-Maize + blackgram, $M_3$-Maize + cowpea $M_4$-Maize + soybean. Sub plots comprised of five treatments with three replications *viz.*,$S_1$- Unweeded check, $S_2$-Hand weeding on 20 and 40 DAS**,** $S_3$- Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe on 30 DAS**,** S4- Alachlor @ 0.2 kg/ha as pre-emergence + one hand weeding on 30 DAS**,** $S_5$-Alachlor @ 0.2 kg/ha as pre-emergence + early post emergence tembotrione on 21 DAS. Need based plant protection measures were taken up based on the economic threshold level of pest and disease.

### Biometric observations on weeds

### Weed density

Weeds in sample quadrates were collected from each plot separately at 30 and 60 DAS and root clipped off, oven dried at 80°C ± 5°C till a constant weight obtained and expressed in g $m^{-2}$.

### Weed control efficiency

Weed Control Efficiency (WCE) was calculated as per the procedure given by Mani *et al* (1973) and expressed in per cent.

$$WCE(percent) = \frac{WPC - WPT}{WPC} X100$$

where,

WPC = Weed population in un weeded control plot

WPT = Weed population in treated plot

## Result and Discussions

### Weed density and weed control efficiency

Among the main plot treatments, inter cropping of maize + cowpea ($M_3$) excelled others by recording the lowest weed density of 34.27 and 42.80 g $m^{-2}$ on 35 and 65 DAS, respectively (Table 1). The same treatment also registered higher weed control efficiency of 81.4 and 78 per cent on 35 and 65 DAS, respectively (Fig 1). This can be attributed to the better performance of cowpea had such a large effect on weed suppression due to its ability to develop over-ground runners, which occupied the inter-row spaces in the intercropped treatments and restricted the germination and growth of weed seeds (Jamshidi *et at*., 2013). Among the sub plot treatments, alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe on 30 DAS recorded lower weed density of 37.97 and 47.34 on 35 and 65 DAS, respectively. This observation was in accordance with the report of (Ramesh and Senthivel, 2019. Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe weeding registered highest weed control efficiency of 82.75 and 79.5 on 35 and 65 DAS, respectively. The results are in conformation with the findings of Bhagirath and Jhoana (2013) who had reported that two hand weeding treatment and integration of herbicide with one hand weeding resulted in significant weed reduction of weed density and weed competition.

### Growth attributes

Among the main plot treatments, maize + cowpea ($M_3$) had significantly registered the highest plant height of 47.05, 117.83 cm at 35 and 65 DAS, respectively and, LAI of 2.33 (Table 2). This might be due to better weed control throughout the growth stages of maize and better availability of all resources *viz*., light, moisture, space and nutrients to maize (Bibi, 2010). Besides, effective utilization of available nutrients which ultimately resulted in increased growth attributes of maize as reported by Gul and Khanday (2015). Among the sub plot treatments, application of Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe 30 DAS ($S_3$) had significantly registered the taller plants of 100.52 cm and LAI of 2.0. This could be mainly due to the reduced weed density and growth thus providing weed free environment due to which all the growth resources were optimally utilized by the crop plants for better vegetative growth that reflected as plant height and dry matter production as reported by Nagasai Vardhan *et al*. (2018). The unweeded check plot registered the least plant height of 21.50.56 cm and LAI of 1.23. This might be attributed to severe weed competition from the beginning of the crop which interfered with nutrient uptake, light and space for rooting resulted in poor growth characters of crop, this is turn in least values of growth attributes under weedy check. This observation was in accordance with the report of Ramesh *et al*. (2019).

### Yield attributes and yield

Among the main plot treatment, maize + cowpea inter cropping system significantly registered higher value of cob length (18.50 cm), Cob diameter (13.85 cm) and number of grains per cob (509). Higher weed control efficiency and low depletion of nutrients by weeds promoted the yield components of maize with maize+ cowpea inter cropping system (Sen *et al*., 2000). The weed management practices, alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe 30 DAS ($S_3$) influenced the grain and stover yield significantly over weedy check. Weed management practices through herbicide application along with one rotary hoeing at 35 DAS recorded significantly higher grain and stover yields over unweeded check. Increasing the nutrient uptake by crop influenced the growth and yield attributes which favoured grain and stover yields of maize. Similar findings were also reported by Walia *et al*. (2007).

The higher grain (71. 66t/ha) and stover (98.48 t/ha) (Table 3) yields were registered with the maize+ cowpea inter cropping system. Rajesh kumar *et al* .2018 reported grain and stover yields were the highest with maize +cowpea inter cropping system. Application of alachlor at 1.0 kg/ha with twin whell hoeing on 30 DAS recorded the higher grain yield (66.80t/ha) and stover yield (93.62) in maize. This was due to lesser crop weed competition for growth resources throughout the crop growth period and availability of congenial environment for better expression of growth and yield potential. Similar findings were reported by Nagasai Vardhan *et al*. (2018).

## Conclusion

Based on the results of the study, it can be concluded that efficient and economic weed management in maize could be achieved by maize + cowpea inter cropping along with application of alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe 30 DAS. It effectively reduced the infestation of weeds and favored the growth attributes, yield attributes, yield of hybrid.

**Table 1 :** Influence of integrated weed management practices on weed density and weed control efficiency at 35 and 65 DAS in maize based intercropping system

| **Treatments** | **weed density ($g\ m^{-2}$)** | | **weed control efficiency** | |
|---|---|---|---|---|
| Cropping system | **35 DAS** | **65 DAS** | **35 DAS** | **65 DAS** |
| $M_1$- Maize sole crop | 50.15 | 55.56 | 42.2 | 39.80 |
| $M_2$- Maize + Blackgram | 36.67 | 50.07 | 63.4 | 59.80 |
| $M_3$- Maize + Cowpea | 34.27 | 42.80 | 81.4 | 78.00 |
| $M_4$- Maize+ Soybean | 41.24 | 52.74 | 71.4 | 68.20 |
| Weed control | | | | |
| $S_1$- Unweeded check | 46.32 | 52.07 | 44 | 41.5 |
| $S_2$-Hand weeding on 20 and 40 DAS | 40.57 | 51.48 | 59.5 | 56.25 |
| $S_3$- Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe on 30 DAS | 37.97 | 48.34 | 82.75 | 79.5 |
| S4- Alachlor @ 0.2 kg/ha as pre-emergence + one hand weeding on 30 DAS | 39.88 | 50.32 | 65.5 | 61.75 |
| $S_5$- Alachlor @ 0.2 kg/ha as pre-emergence + early post emergence tembotrione on 21 DAS | 38.17 | 49.26 | 71.25 | 68.25 |
| SEd | 1.8 | 1.9 | - | - |
| CD (p=0.05) | 4.4 | 3.9 | - | - |

**Table 2 :** Influence of integrated weed management practices on Plant height on 35 DAS and 65 DAS and LAI in maize based intercropping system

| **Treatments** | **Plant height** | | **LAI** |
|---|---|---|---|
| **Cropping system** | **35 DAS** | **65 DAS** | **40 DAS** |
| $M_1$- Maize sole crop | 21.50 | 73.02 | 1.27 |
| $M_2$- Maize + Blackgram | 33.34 | 99.32 | 2.12 |
| $M_3$- Maize + Cowpea | 47.05 | 117.83 | 2.33 |
| $M_4$- Maize+ Soybean | 25.96 | 85.36 | 1.63 |
| Weed control | | | |
| $S_1$- Unweeded check | 28.34 | 87.75 | 1.71 |
| $S_2$-Hand weeding on 20 and 40 DAS | 29.88 | 90.89 | 1.77 |
| $S_3$- Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe on 30 DAS | 35.51 | 100.57 | 2.00 |
| S4- Alachlor @ 0.2 kg/ha as pre-emergence + one hand weeding on 30 DAS | 32.13 | 93.77 | 1.82 |
| $S_5$- Alachlor @ 0.2 kg/ha as pre-emergence + early post emergence tembotrione on 21 DAS | 33.96 | 96.45 | 1.91 |
| SEd | 0.10 | 0.30 | 0.04 |
| CD (p=0.05) | 0.20 | 0.80 | 0.09 |

**Table 3 :** Influence of integrated weed management practices on cob length, co diameter, number of grains per cob, grain yield and Stover yield in maize based intercropping system

| **Treatments** | | | | | |
|---|---|---|---|---|---|
| **Cropping system** | **Cob length** | **Cob diameter** | **Number of grains per cob** | **Grain Yield (kg/ha)** | **Stover yield (kg/ha)** |
| $M_1$- Maize sole crop | 13.60 | 11.73 | 439.6 | 4972 | 7654 |
| $M_2$- Maize + Blackgram | 16.06 | 13.08 | 484.2 | 6775 | 9457 |
| $M_3$- Maize + Cowpea | 18.50 | 13.86 | 509 | 7166.4 | 9848.4 |
| $M_4$- Maize+ Soybean | 14.88 | 12.33 | 459.6 | 6321.4 | 9003.4 |
| Weed control | | | | | |
| $S_1$- Unweeded check | 15.17 | 12.46 | 464.25 | 5808.5 | 8490.5 |
| $S_2$-Hand weeding on 20 and 40 DAS | 15.58 | 12.59 | 469.5 | 6248.5 | 8930.5 |
| $S_3$- Alachlor @ 0.2 kg/ha as pre-emergence + twin wheel hoe on 30 DAS | 16.25 | 13.04 | 482.5 | 6680.25 | 9362.25 |
| S4- Alachlor @ 0.2 kg/ha as pre-emergence + one hand weeding on 30 DAS | 15.73 | 12.76 | 473 | 6331.5 | 9013.5 |
| $S_5$- Alachlor @ 0.2 kg/ha as pre-emergence + early post emergence tembotrione on 21 DAS | 16.05 | 12.91 | 476 | 6474.75 | 9156.75 |
| SEd | 1.6 | 1.4 | 9 | 24 | 211 |
| CD (p=0.05) | 3.2 | 2.8 | 23 | 50 | 466 |

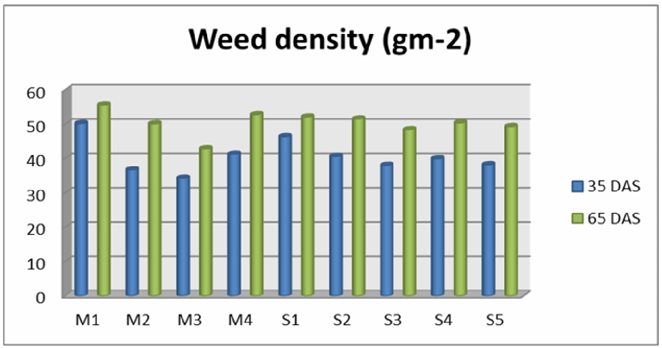


**Fig. 1 :** Influence of integrated weed management practices on weed density ($gm^{-2}$) in maize based intercropping system

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