

Original Research Article

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Growth and Yield of Maize as Influenced by Sequential Application of Herbicides

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ABSTRACT

Keywords

Halosulfuron-methyl, Maize, Pre-emergence, Post-emergence, Weed management practices, Tembotrione

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A total of ten treatments were evaluated in a randomized block design (RBD) with three replications on sandy loam soils of Tirupati, Andhra Pradesh. The treatments comprised of pre-emergence herbicides (alachlor 1000 g ha⁻¹ and atrazine 1000 g ha⁻¹) followed by post-emergence herbicides (Halosulfuron-methyl 67.5 g ha⁻¹, Tembotrione 100 g ha⁻¹ and 2,4-D sodium salt). Among the different pre-and post-emergence herbicides applied, pre-emergence application of alachlor 1000 g ha⁻¹ *fb* post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ + tembotrione 100 g ha⁻¹ imposed to maize resulted in higher number of yield attributes which ultimately results in higher grain yield. Unweeded check recorded the lowest values, which was due to severe weed competition. The yield reduction due to unweeded check accounts to 53.91 and 53.44 per cent.

Introduction

The renowned Nobel Laureate, Dr. Norman E. Borlaug believed that “The last two decades saw the revolution in rice and wheat, the next few decades will be known for maize era”. Maize (*Zea mays* L.) is the most versatile and miracle food crop of global importance. It is cultivated in the tropics, sub-tropics, temperate and semi-arid regions. It is one of the most efficient crop gives high biological

yield as well as grain yield in a short period of time due to its unique C₄ photosynthetic mechanism. Maize is also called as “King of Cereals”. It ranks third most important cereal crop after rice and wheat. In India, maize was cultivated in an area of 9.18 million hectares with a production of 24.17 million tonnes and average productivity of 2632 kg ha⁻¹ during 2014-15. In Andhra Pradesh, it was grown in an area of 3 lakh hectares with production of 19.38 lakh tonnes and average productivity of

6396 kg ha⁻¹ during 2014-15 (www.indiastat.com). Low yield of maize under Indian conditions may be attributed due to number of factors, among them weeds rank as prime enemy. Hand weeding is the commonest and effective method of control of weeds, however, it is not only intensive, but also expensive and strenuous. The extent of yield loss due to weeds in maize varies from 28 to 93 per cent depending on the type of weed flora, intensity and duration of crop weed competition. Chemical weed management is the viable option in maize crop as highly selective post-emergence herbicides are available.

Materials and Methods

Field experiment was conducted during *khari* season of 2016 on sandy loam soils of wetland farm of S. V. Agricultural College, Tirupati, Acharya N. G. Ranga Agricultural University, Andhra Pradesh, India. The experimental field was situated at about 13.5°N latitude and 79.5°E longitude, at an altitude of 182.9 m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. The soil of the experimental field was neutral in reaction (pH 7.4), low in organic carbon (0.63 dS m⁻¹) and available nitrogen (240 kg ha⁻¹) and medium in available phosphorus (25.50 kg ha⁻¹) and available potassium (285 kg ha⁻¹). Ten treatments comprising of pre-emergence application of alachlor 1000 g ha⁻¹ (W₁), post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ (W₂), post-emergence application of tembotrione 100 g ha⁻¹ (W₃), post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ + tembotrione 100 g ha⁻¹ (W₄), pre-emergence application of alachlor 1000 g ha⁻¹ + post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ (W₅), pre-emergence application of alachlor 1000 g ha⁻¹ + post-emergence application of tembotrione 100 g ha⁻¹ (W₆), pre-emergence application of alachlor 1000 g ha⁻¹ *fb* post-emergence

application of halosulfuron-methyl 67.5 g ha⁻¹ + tembotrione 100 g ha⁻¹ (W₇), pre-emergence application of atrazine 1000 g ha⁻¹ + post-emergence application of 2,4 D- sodium salt 800 g ha⁻¹ (W₈), two hand weeding at 20 and 40 DAS (W₉) and unweeded control (W₁₀) were assigned in a randomized block design with three replications. The recommended dose of fertilizers *viz.* 200 kg N, 60 kg P₂O₅ and 50 kg K₂O ha⁻¹ were applied. Entire dose of phosphorous and potassium and 1/4th dose of nitrogen were applied as basal. Remaining nitrogen was applied in splits at knee height, tasselling and silking stages.

All the herbicides alone or in combination were applied uniformly in the experimental plots with the help of knapsack sprayer fitted with flat fan nozzle using a spray volume of 500 l/ha. All the recommended agronomic and plant protection measures were adopted to raise crop. The data on weed density and weed dry weight were recorded at different growth stages of maize crop. These were subjected to square root transformation to normalize their distribution. Benefit-cost ratio was determined by dividing gross returns with cost of cultivation. Grain yield of maize along with other yield attributing characters like number of seeds cob⁻¹ and test weight *etc* were recorded at harvest.

Results and Discussion

Major weed flora of the experimental field was *Cyperus rotundus*, *Digitaria sanguinalis*, *Boerhavia erecta*, *Borreria hispida*, *Trichodesma indicum*, *Phyllanthus niruri* and *Digera arvensis*. The lowest weed density and highest weed control efficiency were recorded with the treatment pre-emergence application of alachlor 1000 g ha⁻¹ *fb* post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ + tembotrione 100 g ha⁻¹. While the lowest weed dry weight were noticed with hand weeding twice at 20 and 40 DAS.

Table.1 Weed growth, yield components and yield of *kharif* maize as influenced by sequential application of herbicides and seedling vigour index of succeeding greengram

Treatment	Dose (g ha ⁻¹)	Time of application	Weed density (m ⁻²)	Weed dry weight (g m ⁻²)	Weed control efficiency (%)	Plant height (cm)	Leaf area index	Dry matter production (kg ha ⁻¹)	Number of seeds cob ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Benefit-cost ratio	Seedling vigour index at 15 DAS (Greengram)
Alachlor	1000	1 DAS	113.32 (10.67)	117.61 (10.87)	49.96 (44.94)	168.56	1.33	9181	301.7	25.24	3494	5239	2.34	1814
Halosulfuron-methyl	67.5	20 DAS	109.66 (10.50)	110.17 (10.52)	53.12 (46.78)	163.24	1.10	7822	241.8	24.01	2954	4494	1.69	1813
Tembotrione	100	20 DAS	114.99 (10.74)	132.95 (11.55)	43.43 (41.21)	163.62	1.27	8626	248.2	24.78	3328	4977	2.01	1833
Halosulfuron-methyl <i>fb</i> tembotrione	67.5+100	20 DAS	72.65 (8.55)	41.08 (6.45)	82.52 (65.27)	171.24	1.50	10025	325.5	26.56	3839	5671	1.94	1818
Alachlor <i>fb</i> halosulfuron-methyl	1000+67.5	1+20 DAS	59.32 (7.73)	32.28 (5.73)	86.26 (68.28)	182.8	1.66	10751	364.4	27.33	4186	5964	2.26	1928
Alachlor <i>fb</i> tembotrione	1000+100	1+20 DAS	55.99 (7.52)	71.74 (8.50)	69.47 (56.48)	188.64	1.74	11086	390.0	28.35	4312	6081	2.46	1850
Alachlor <i>fb</i> halosulfuron-methyl+ tembotrione (Tank mix)	1000+67.5+100	1+20 DAS	27.32 (5.27)	18.71 (4.38)	92.03 (73.57)	198.33	1.87	12398	447.8	29.04	4863	6805	2.34	1964
Atrazine <i>fb</i> 2,4-D Sodium salt	1000+800	1+20 DAS	67.66 (8.26)	45.81 (6.81)	80.51 (63.79)	176.64	1.58	10422	340.5	26.67	4054	5779	2.66	1835
Two hand weedings	-	20 and 40 DAS	29.99 (5.52)	11.86 (3.52)	94.95 (76.95)	192.86	1.81	11691	443.3	28.33	4554	6380	2.46	1959
Unweeded check	-		209.32 (14.49)	235.05 (15.35)	-	154.58	1.06	6526	206.4	23.58	2255	3960	1.62	1807
CD(P=0.05)			0.24	0.32	4.12	2.47	0.06	314	14.37	0.33	208.0	316.0	0.06	131

Figures in parenthesis indicates square root transformed ($\sqrt{X+0.5}$) values

Fig.1 Dry matter production and plant height of maize at harvest as influenced by different weed management practices

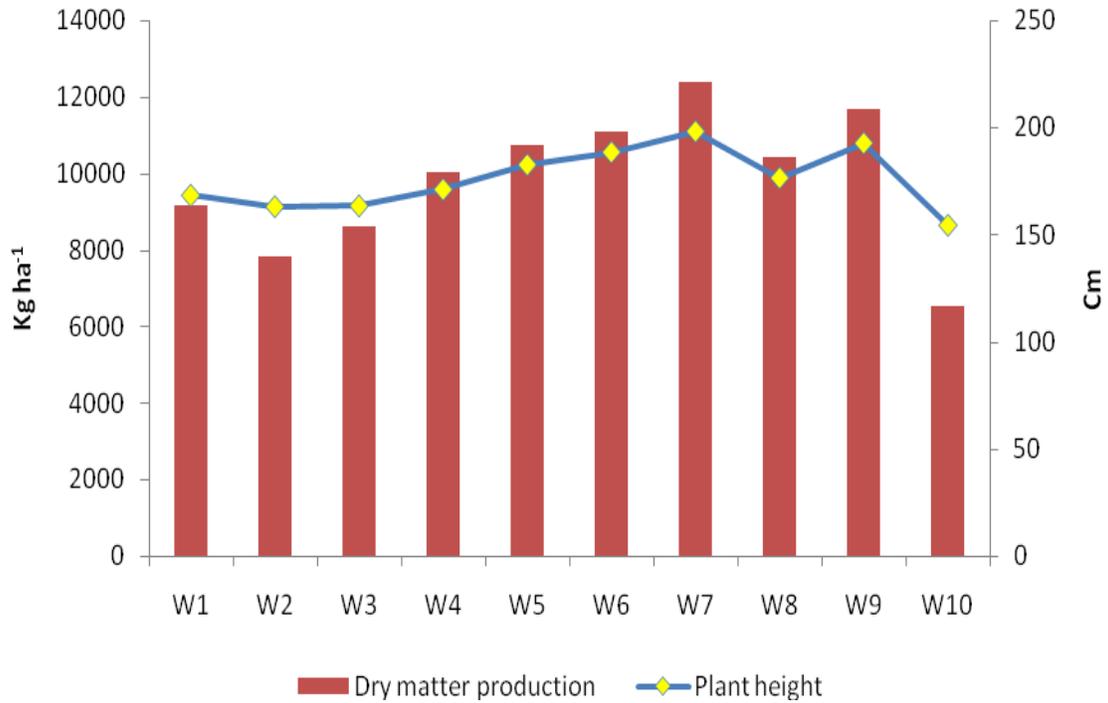


Fig.2 Leaf area index of maize at harvest as influenced by different weed management practices

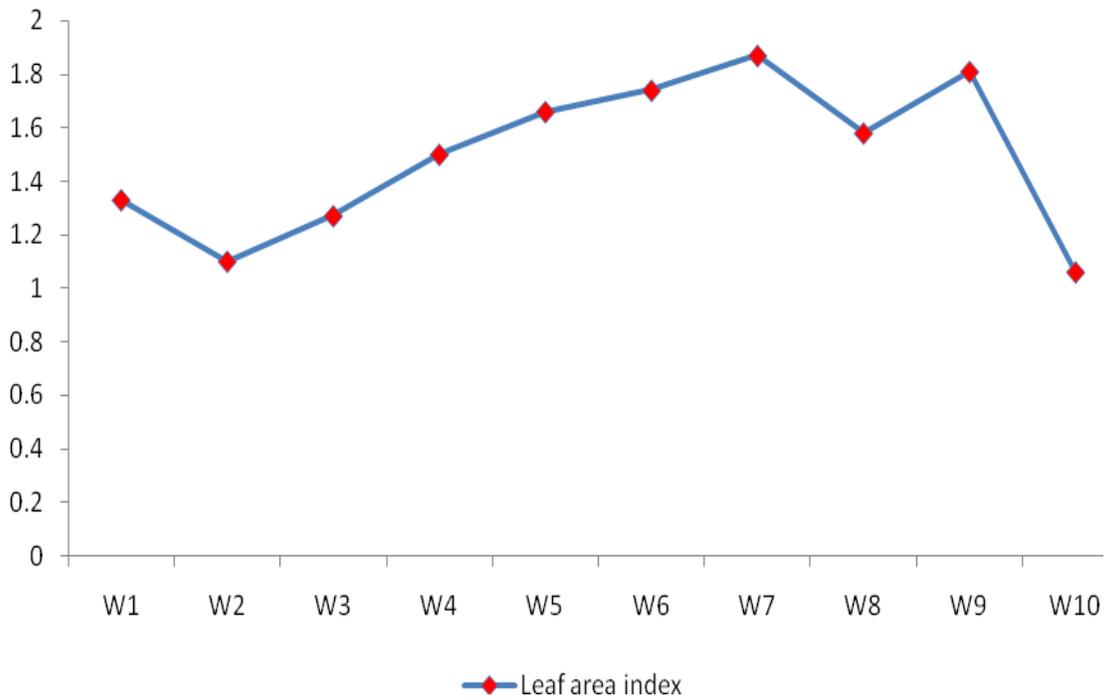


Fig.3 Number of grains cob⁻¹ and test-weight of maize as influenced by different weed management practices

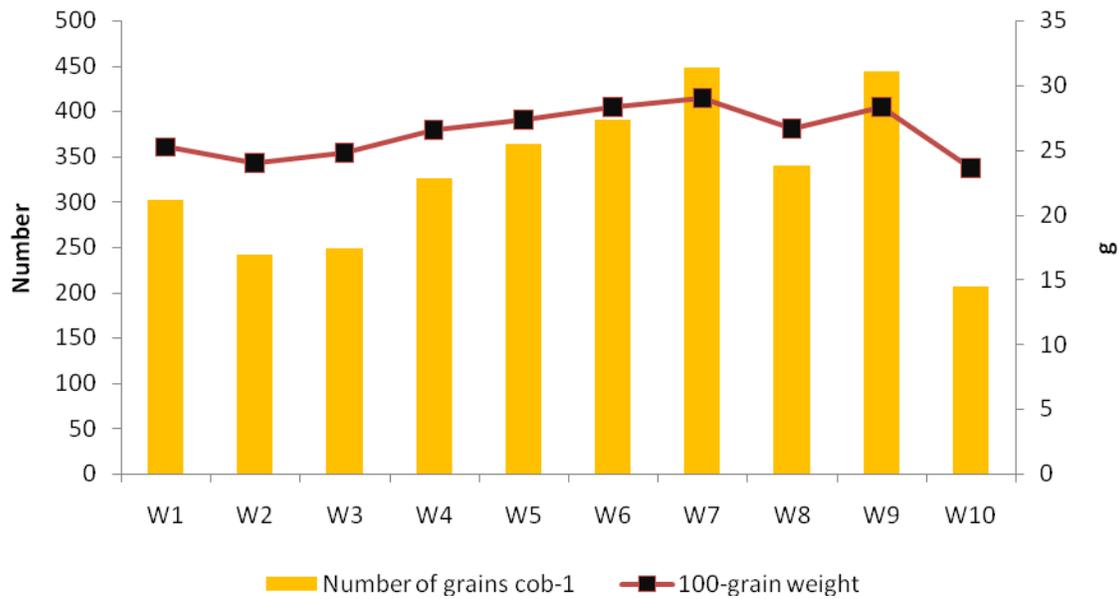
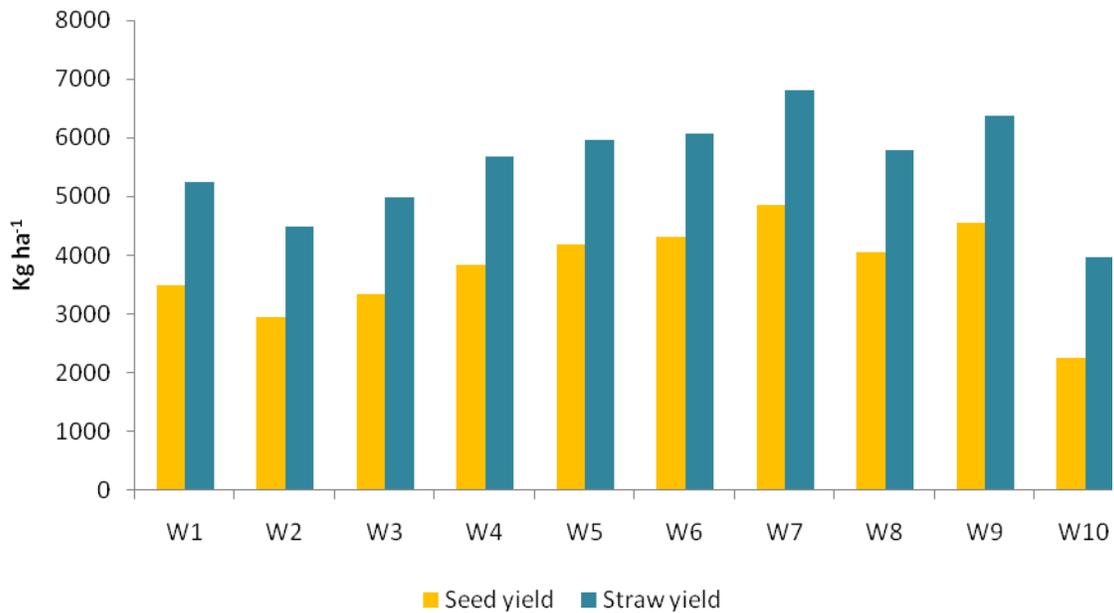


Fig.4 Seed yield and straw yield of maize as influenced by different weed management practices



Different weed management practices exhibited significant influence on all the yield attributes studied (Table 1). Among them, the weed management practice with pre-

emergence application of alachlor 1000 g ha⁻¹ + post-emergence application of halosulfuron-methyl 67.5 g ha⁻¹ + tembotrione 100 g ha⁻¹ recorded higher yield attributes,

viz. plant height, leaf area index, dry matter production, number of seeds cob^{-1} and test weight followed by two hand weedings at 20 and 40 DAS. The higher plant height were noticed due to effective control of weeds, owing to reduced crop weed competition during the critical stages of crop growth, which in turn resulted in rapid cell multiplication and elongation, leading to increase in internodal length. These results are in conformity with findings of Abdullahi *et al.*, (2016). Higher leaf area index might be due to lesser weed competition during early and critical stages of crop leads to better resource use efficiency, which in turn increased the number and size of the leaves. These results are in accordance with findings of Umesha *et al.*, (2015). Higher dry matter production might be due to effective control of all the categories of weeds during the critical period of crop weed competition leads to production of more number of leaves plant^{-1} . Similar results were also reported by Pratap Singh *et al.*, (2012). Higher number of seeds cob^{-1} and test weight might be due to better translocation of photosynthates from source to sink as a result of efficient utilization of growth resources because of weed free conditions. These results are in agreement with those of Pratik Sanodiya *et al.*, (2013). The various weed management practices showed significant impact on seed yield of maize. Treatment pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} registered highest seed yield and straw yield of maize followed by hand weeding twice at 20 and 40 DAS. Higher benefit-cost ratio was obtained with pre-emergence application of atrazine 1000 g a.i ha^{-1} *fb* post-emergence application of 2,4-D sodium salt 800 g a.i ha^{-1} , because of the lesser cost of chemicals. Higher seedling vigour index of succeeding greengram at 15 DAS was recorded with pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-

emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied to maize crop, which was however comparable with two hand weedings. The increased seedling vigour index in the above said weed management practice was mainly due to better root and shoot length as a result of reduced weed density and dry weight of weeds during early stages of greengram (Fig. 1–4).

It was concluded that pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} was found to be a suitable and effective herbicidal weed management practice for *kharif* maize, because it controls weed density and dry weight very effectively, which ultimately results in increased yield attributes and yield of maize. The next best practice was two hand weedings followed by pre-emergence application of alachlor 1000 g a.i ha^{-1} + post-emergence application of tembotrione 100 g a.i ha^{-1} .

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