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## Efficacy of different pre and post emergence herbicides on nutrient uptake and microbial observation in maize (*Zea mays* L.)

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### Abstract

A field investigation entitled "Efficacy of different pre and post emergence herbicides on weed control in maize (*Zea mays* L.)" was carried out at AICRP on weed management field of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the kharif season of 2018. The investigation was carried out to study the relative efficacy of herbicides on weed control in maize as well as to study its effect on growth and yield of maize. The experiment was laid out in randomized block design with twelve treatment replicated thrice. Microbial count (Bacteria, Fungi, Actinomycetes) in weedy check treatment found highest count followed by weed free over rest of the treatments. Uptake of NPK in grain, straw and total uptake by maize was significantly more with weed free treatment followed Atrazine 0.50kg/ha *fb* tembotrione 0.120 kg/ha PoE 20 DAS, Similar treatments recorded lowest NPK uptake by weeds.

**Keywords:** Weed index, weed control efficiency, weed flora, soil microflora, selective, broad spectrum, monocot, pre emergence, post emergence, efficacy, weedy check

### Introduction

One of the oldest food grains is maize (*Zea mays* L.) and the only cultivated species in its genus. It is known by various common names but the most popular name is maize or corn (Paliwal, 2000) [11]. It plays a vital role in ensuring food security as well as nutritional security through the quality protein (Rawool, 2004) [12]. Maize is the third most important cereal crop in terms of production of cereals of the world (Ochse *et al.*, 1996) [9]. In India, it is cultivated over an area of 8.38 m ha with production of 19.78 m tonnes and productivity is 2361 kg ha<sup>-1</sup>. Successful maize production depends on the correct application of production of inputs that will sustained the environment as well as the agricultural production. These inputs are, inter alia, adapted cultivars, plant population, soil tillage, fertilisation, weed, insect and diseases control, harvesting, marketing and financial resources (Kalhapure *et al.*, 2013) [7]. Amongst these production factors, weed management plays a major role in increasing the productivity of maize (Barla *et al.*, 2016) [1]. Unchecked weed growth in maize crop may result in grain yield losses to the extent of 28-100% (Das *et al.*, 2012) [4] and the nutrient loss varies from 30 to 40% of the applied nutrients (Chopra and Angiras 2008) [3]. Management of weeds through integration of the crop by decreasing the biomass and nutrient removed by weeds. Chemical weed management by using pre or post emergence herbicides can lead to efficient and cost effective control of weeds during the critical period of crop weed competition, which may not be possible in manual or mechanical weeding due to its high cost of cultivation (Triveni *et al.*, 2017) [14]. Keeping the above aspects in view, the present investigation was carried out to find out the effect of herbicides on nutrient uptake by crop as well as weeds and also find out effect on soil microorganism.

### Material and Methods

The field experiment was conducted during Kharif season of the year 2018-19 in the field plot No.88 at the AICRP on Weed Management, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The soil of experimental field characterized as clay loam in texture, having slightly alkaline pH (7.5), moderate organic carbon status (5.38%), low nitrogen content (219.33 kg ha<sup>-1</sup>), medium available phosphorus content (15.30 kg ha<sup>-1</sup>) and high available potassium (340.67 kg ha<sup>-1</sup>). Maize (Pioneer hybrid 3396) was sown on 25<sup>th</sup> June 2018 at 60 × 20 cm spacing with 120:60:30 NPK kg ha<sup>-1</sup>. The crop was harvested on 12<sup>th</sup> October 2018. The experiment was laid out in randomized block design with twelve treatment

replicated thrice. The treatments comprised of Atrazine @ 1 kg a.i/ha (T<sub>1</sub>), Pendimethalin @ 1kg/ha (T<sub>2</sub>), Metribuzin 0.35 kg/ha (T<sub>3</sub>), Atrazine 0.50 kg/ha + Pendimethalin 0.50 kg/ha (T<sub>4</sub>), 2,4-D sodium salt @ 0.80 kg/ha (T<sub>5</sub>), Tembotrione 0.120 kg/ha (T<sub>6</sub>), Atrazine 0.50 kg/ha *fb* 2,4-D sodium salt @ 0.5kg/ha (T<sub>7</sub>), Atrazine 0.50 kg/ha *fb* tembotrione 0.120 kg/ha (T<sub>8</sub>), Topramezone 0.0252 kg/ha (T<sub>9</sub>), Halosulfuron methyl 0.05 kg/ha (T<sub>10</sub>), Weed free (T<sub>11</sub>), Weedy check (T<sub>12</sub>). Observation on weed density, weed dry matter, yield attributes, nutrient uptake and microbial count were recorded.

## Results and Discussion

### Effect on nutrients uptake by crop

Nutrient uptake by crop is a function of nutrient content in dry matter and the dry matter production. Nutrient content is related to the photosynthetic activity of leaves, because the

essential nutrients viz., N, P and K are directly and indirectly involved in photosynthesis and respiration.

The data in Table 1. revealed that the total uptake of nitrogen, phosphorous and potassium was 228.80 kg ha<sup>-1</sup>, 31.53 kg ha<sup>-1</sup> and 119.51 kg ha<sup>-1</sup> respectively. Maximum nutrient uptake by grain, straw were found with treatment Weed free (T<sub>11</sub>) followed by Atrazine 0.50kg/ha *fb* tembotrione 0.120 kg/ha (T<sub>8</sub>) and treatment Atrazine@ 1 kg a.i/ha (T<sub>1</sub>). All the weed management treatments registered higher uptake by the crop than weedy check. The result showed that the NPK uptake by plant was highest in treatment Weedy free (T<sub>11</sub>), it might due to less competition of plant and weed for nutrient, but in treatment Weedy check (T<sub>12</sub>) the rate of uptake of NPK by plants was very slow. This is due to weed suppress the vegetative growth of plants by competition to light, moisture and nutrient.

**Table 1:** Nutrient (NPK) uptake by crop (kg ha<sup>-1</sup>) as influenced by weed control treatments in maize.

Treatments	N uptake (kg ha <sup>-1</sup> )			P uptake (kg ha <sup>-1</sup> )			K uptake (kg ha <sup>-1</sup> )		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T <sub>1</sub> :Atrazine 1 kg a.i/ha PE	110.58	139.49	250.07	26.85	8.83	35.68	47.00	87.69	134.69
T <sub>2</sub> : Pendimethalin 1 kg/ha PE	82.59	111.69	194.28	18.03	7.23	25.26	23.66	78.50	102.16
T <sub>3</sub> : Metribuzin 0.35 kg/ha PE	86.27	113.46	199.73	18.92	7.40	26.32	24.21	79.78	103.99
T <sub>4</sub> : Atrazine 0.50 kg + Pendimethalin 0.50kg/ha PE	98.22	126.42	224.65	21.92	8.08	30.00	27.63	82.48	110.11
T <sub>5</sub> :2,4-D sodium salt @ 0.80 kg/ha POE 30 DAS	95.49	123.96	219.44	20.58	7.60	28.18	25.69	80.85	106.54
T <sub>6</sub> :Tembotrione 0.120 kg/ha POE 20 DAS	103.30	131.86	235.16	23.14	8.36	31.50	31.64	84.73	116.37
T <sub>7</sub> :Atrazine 0.50 kg /ha <i>fb</i> 2,4-D sodium salt @ 0.50 kg/ha POE 30 DAS	113.58	143.54	257.12	28.61	9.28	37.89	50.04	94.57	144.61
T <sub>8</sub> :Atrazine 0.50 kg/ha <i>fb</i> tembotrione 0.120 kg/ha POE 20 DAS	117.08	147.32	264.40	29.48	9.66	39.14	50.84	95.33	146.17
T <sub>9</sub> :Topramezone 0.0252 kg/ha POE 20 DAS	105.21	134.48	239.68	24.82	8.59	33.41	34.42	85.04	119.46
T <sub>10</sub> :Halosulfuron methyl 0.05 kg/ha POE 20 DAS	89.14	117.01	206.15	19.58	7.48	27.06	24.59	80.10	104.69
T <sub>11</sub> :Weed free	119.11	149.01	268.11	29.86	9.90	39.76	51.30	97.39	148.69
T <sub>12</sub> :Weedy check	75.22	107.23	182.45	17.10	7.13	24.23	21.53	75.28	96.81
SE (M)±	4.33	5.46	9.18	1.25	0.60	1.48	1.62	3.81	5.15
C. D. at 5%	12.69	15.99	26.88	3.63	1.75	4.33	4.75	11.16	15.09
GM	99.65	128.79	228.80	23.24	8.30	31.53	34.38	85.15	119.51

### Effect on nutrients uptake by weeds

The weeds usually grow faster than the associated crop plants and thus absorb the available nutrients in more amount and lead to the deficiency of nutrients in the crop plants. Competition begins when the root system of the crop and weeds overlap in the exploring soil profile and shows the enhanced competition for nutrients.

Weed management practices significantly influenced the N, P and K depletion by weeds. The removal of nutrients (NPK) by

weeds significantly less in treatment Weed free (T<sub>11</sub>). It was the highest under Weedy check (T<sub>12</sub>) and Pendimethalin @ 1kg/ha (T<sub>2</sub>). The increase in the depletion of N, P and K by weeds under this treatment was due to the No control and poor control of weeds that resulted in the highest dry weight of weed. Sequential application of Atrazine 0.50kg/ha *fb* tembotrione 0.120 kg/ha (T<sub>8</sub>), recorded the lowest nutrient uptake and it was at par with Atrazine @ 1 kg a.i/ha (T<sub>1</sub>). This might be due to effective control of weeds.

**Table 2:** Nutrient uptake (N, P and K) by weeds (Kg ha<sup>-1</sup>) as influenced by weed control treatments in maize

Treatments	N (kg ha <sup>-1</sup> )	P (kg ha <sup>-1</sup> )	K (kg ha <sup>-1</sup> )
T <sub>1</sub> :Atrazine 1 kg a.i/ha PE	13.78	2.25	7.90
T <sub>2</sub> : Pendimethalin 1 kg/ha PE	27.85	3.66	10.53
T <sub>3</sub> : Metribuzin 0.35 kg/ha PE	25.61	3.49	10.23
T <sub>4</sub> : Atrazine 0.50 kg + Pendimethalin 0.50kg/ha PE	19.65	2.74	8.94
T <sub>5</sub> :2,4-D sodium salt @ 0.80 kg/ha POE 30 DAS	21.95	3.15	9.17
T <sub>6</sub> :Tembotrione 0.120 kg/ha POE 20 DAS	16.55	2.67	8.64
T <sub>7</sub> :Atrazine 0.50 kg /ha <i>fb</i> 2,4-D sodium salt @ 0.50 kg/ha POE 30 DAS	11.92	2.15	7.68
T <sub>8</sub> :Atrazine 0.50 kg/ha <i>fb</i> tembotrione 0.120 kg/ha POE 20 DAS	10.95	2.07	7.35
T <sub>9</sub> :Topramezone 0.0252 kg/ha POE 20 DAS	15.38	2.45	8.12
T <sub>10</sub> :Halosulfuron methyl 0.05 kg/ha POE 20 DAS	24.83	3.25	9.74
T <sub>11</sub> :Weed free	0.00	0.00	0.00
T <sub>12</sub> :Weedy check	36.49	4.88	24.57
SE (M)±	0.84	0.19	0.62
C. D. at 5%	2.48	0.57	1.83
GM	18.75	2.73	9.40

### Effect on soil microbial activity

Data pertaining to effect of herbicide on soil Microbial count at different growth stages of the crop are presented in Table 3. Before sowing there were non-significant differences in microbial population. There was decrease in population after spraying of herbicides. But at the time of harvest of the crop, the microbial population with all the treatments attained, the level or slightly reduced than original level of population in

some treatments. Microbial population after spray was significantly higher in treatment Weedy check ( $T_{12}$ ) than rest of the treatments however it was at par with treatment Weed free ( $T_{11}$ ). From the herbicidal treatments Atrazine 0.50kg/ha *fb* tembotrione 0.120 kg/ha ( $T_8$ ) and treatment Atrazine@ 1 kg a.i/ha ( $T_1$ ) recorded highest microbial counts as compare to other treatments. Similar results were reported by Pal *et al.* (2009)<sup>[10]</sup> and Ghosh *et al.* (2012)<sup>[6]</sup>.

**Table 3:** Microbial count (Bacteria, Fungi and Actinomycets) influenced by different weed control treatments

Treatments	Bacteria			Fungi			Actinomycets		
	Before sowing	After spray	At harvest	Before sowing	After spray	At harvest	Before sowing	After spray	At harvest
$T_1$ :Atrazine 1 kg a.i/ha PE	27	22	26	20	16	19	22	17	20
$T_2$ : Pendimethalin 1 kg/ha PE	24	18	22	16	10	13	19	14	18
$T_3$ : Metribuzin 0.35 kg/ha PE	26	20	23	18	13	16	21	16	19
$T_4$ : Atrazine 0.50 kg + Pendimethalin 0.50kg/ha PE	26	21	24	19	14	18	21	17	20
$T_5$ :2,4-D sodium salt @ 0.80 kg/ha POE 30 DAS	25	22	24	16	14	15	20	17	22
$T_6$ :Tembotrione 0.120 kg/ha POE 20 DAS	25	23	26	17	15	18	20	18	23
$T_7$ :Atrazine 0.50 kg /ha <i>fb</i> 2,4-D sodium salt @ 0.50 kg/ha POE 30 DAS	26	23	28	20	16	21	22	20	24
$T_8$ :Atrazine 0.50 kg/ha <i>fb</i> tembotrione 0.120 kg/ha POE 20 DAS	27	25	29	21	18	23	23	20	26
$T_9$ :Topramezone 0.0252 kg/ha POE 20 DAS	26	22	27	19	17	20	21	18	23
$T_{10}$ :Halosulfuron methyl 0.05 kg/ha POE 20 DAS	24	21	22	16	13	17	19	16	16
$T_{11}$ :Weed free	29	30	33	22	24	27	25	27	28
$T_{12}$ :Weedy check	28	32	34	23	26	28	24	29	24
SE (M) $\pm$	1.38	1.09	1.54	1.75	0.60	1.41	1.43	0.85	1.51
C. D. at 5%	NS	3.20	NS	NS	1.76	NS	NS	2.51	NS

### Conclusion

From the experimental results, it could be concluded that the nutrient N, P and K uptake by weeds was observed highest in weedy check. Whereas, in maize total nutrient uptake was maximum when application of Atrazine 0.50 kg/ha as pre-emergence *fb* tembotrione 0.120 kg/ha as post emergence at 20 DAS applied. Also the microbial population after spray of herbicide was reduced to some extent while at harvesting stage the microbial population was recovered or slightly increased and microbial population are highest in treatment  $T_8$  which was Atrazine 0.50 kg/ha PE *fb* tembotrione 0.120 kg/ha as PoE 20 DAS.

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