

Effect of Pre and Post Emergence Herbicides on Nutrients Uptake and Soil Microflora in Maize

Joyti Jaybhaye, S.U. Kakade*, J.P. Deshmukh, S.S. Thakare and M.S. Solanke

All India Coordinated Research Project on Weed Management, Department of Agronomy,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola – 444104(M.S)

*Corresponding Author E-mail: snjyakade@gmail.com

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ABSTRACT

A field investigation entitled “Effect of pre and post emergence herbicides on nutrients uptake and soil microflora in maize (*Zea mays* L.)” was carried out at AICRP on weed management field of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during Kharif season of the year 2018-19 with an objective to study the effect of herbicides on nutrient uptake and soil microflora in maize. The experiment was laid out in randomized block design with twelve treatment replicated thrice. 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⁻¹), medium available phosphorus content (15.30 kg ha⁻¹) and high available potassium (340.67 kg ha⁻¹). Maize (Pioneer hybrid 3396) was sown on 25th June 2018 at 60×20 cm spacing with 120:60:30 NPK kg ha⁻¹. The results revealed that there was a significant differences in uptake of major nutrients N, P and K by crop and maximum total nitrogen, phosphorus and potassium uptake of 268.11, 39.76 and 148.69 kg ha⁻¹ respectively was recorded in weed free treatment followed by atrazine 0.50kg/ha fb tembotrione 0.120 kg/ha (264.40, 39.14 and 146.17 NPK kg ha⁻¹) and treatment Atrazine 0.50 kg/ha fb 2,4-D sodium salt @ 0.5kg/ha. As regards to uptake by weed, weedy check treatment showed maximum uptake (36.49, 4.88, 24.57 NPK kg ha⁻¹) of major nutrients than all other treatments of chemical herbicides and weed free plots. Effect of herbicides after spraying significantly influenced the population of soil microorganisms viz., bacteria, fungi and actinomycetes as compared to their population before herbicide application. But at the time of harvest of the crop the microbial population with all the treatments attained the equal level.

Key words: Maize, Nutrient uptake Pre-emergence, Post-emergence, Soil microflora,

INTRODUCTION

Maize (*Zea mays* L.) being one of the most important cereals and has attained a commercial crop status and has scope to

increase the present maize yields. In India, maize occupies a proud place both as food and feed for animals and it is the third important food crops after rice and wheat.

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Rainy season maize suffers from severe weed competition and depending upon the intensity, nature, stages and duration of weed infestation; yield losses vary from 28-100 per cent (Patel et al., 2006). A wide spaced crop suffers from heavy weed infestation due to slow initial growth particularly during *Kharif* season. They interfere with efficiency of fertilizer utilization by crops plants because a sizeable portion of the fertilizer added to the soil is used by weed. Weeds are regarded as pest of crops because they lower down the productivity, increase the cost of production and inferior the quality of produce. The quantities of growth factors used by weeds are thus unavailable to the crop.

Management of weeds is considered to be an important factor for achieving higher productivity. Yield loss occurs up to 33% to complete crop failure due to weed competition in maize. Weeds also pose severe problems for crop husbandry and infest fallow land, reduce soil fertility and moisture conditions and develop a potential threat to the succeeding crops (Khan et al., 2003). Weed generally compete with the crop plants for nutrients and depletes 30-40 per cent of applied nutrients from the soil. There is severe competition among weeds and crops for major nutrients like N, P and K. Kour et al. (2014) reported that the maximum removal of N, P and K by weeds was recorded with weedy check due to higher dry matter of weeds which enabled them to absorb more nutrients. Herbicides not only control the weeds timely and effectively but also offer great scope for minimizing the cost of weed control irrespective of the situation. The conventional method of weed control (hoeing/ hand weeding) are very laborious, expensive and time consuming and needs to be often repeated at different intervals. Frequent rainfall during rainfed cropping season does not permit manual and mechanical methods of weeding at the appropriate time. Use of pre and post emergence application of herbicides would make herbicidal weed control more acceptable to farmers which will not change the existing agronomic practices but will allow for

complete control of weeds. Chemical weed management by using pre emergence and post emergence herbicides can lead to the efficient and cost effective control of weeds during 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).

Though herbicides have emerged as an important tool in management of weeds. Herbicides use is increasing throughout the globe due to increasing cost, choice of application of herbicides, quick weed control in crop and non crop areas etc. herbicides are chemical in nature therefore excessive and repeated use may pose residue problems and adverse effect on soil microflora. Nowadays soil health and microbial diversity have become vital issues for the sustainable agriculture. Loss of microbial biodiversity can affect the functional stability of the soil microbial community and soil health. Generally, negative effects of herbicides on the population level or composition of species are decreased for a while but subsequently improves. Beneficial organism known to be affected negatively by specific herbicides includes nitrogen fixing bacteria (*Rhizobium*) and some mycorrhizal fungi. Actinomycetes are relatively resistant to herbicides and affected at high concentration only. Fungi are probably the more sensitive to the majority of herbicides than are bacteria. The present investigation was therefore planned with an objective to study the effect of herbicides on nutrient uptake and soil microflora in maize (*Zea mays* L.).

MATERIALS AND METHODS

The present field experiment was conducted during *Kharif* season of the year 2018-19 at the research farm of AICRP-Weed Management, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) in Randomized Block Design with three replication having twelve different treatments of weed management including Atrazine@1 kg a.i/ha. (T₁), Pendimethalin@1kg/ha (T₂), Metribuzin 0.35 kg/ha(T₃), Atrazine 0.50kg/ha +

Pendimethalin 0.50kg/ha. (T₄), 2,4-D sodium salt@ 0.80 kg/ha (T₅), Tembotrione 0.120 kg/ha(T₆), Atrazine 0.50 kg/ha fb 2,4-D sodium salt @0.5kg/ha (T₇), Atrazine 0.50 kg/ha fb tembotrione 0.120 kg/ha(T₈), Topramezone 0.0252kg/ha (T₉), Halosulfuron methyl 0.05 kg/ha (T₁₀), Weed free (T₁₁) and Weedy check (T₁₂). 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⁻¹), medium available phosphorus content (15.30 kg ha⁻¹) and high available potassium (340.67 kg ha⁻¹). Maize (Pioneer hybrid 3396) was sown on 25th June 2018 at 60 × 20 cm spacing with 120:60:30 NPK kg ha⁻¹. The crop was harvested on 12th October, 2018. The application of herbicide was done as per the treatments with manually operated knapsack sprayer attached with a flood jet nozzle. After calibrating the sprayer, water volume used was 700 lit. per ha. for PE and 500 lit. per ha. for PoE. The total nitrogen in the composite crop and weed samples were estimated by modified Kjeldhal's method (Jackson, 1967) and expressed in percentage on dry weight basis. Phosphorous content in the plant and weed samples was determined by Venadomolybdate phosphoric yellow colour method using spectrophotometer at 470 nm as described by Jackson (1967) and was expressed as percentage of phosphorous. Potassium content in the plant and weed samples were determined by Flame photometer method and were expressed as percentage potassium. Nitrogen, phosphorus and potassium percent and total dry weight of weeds were used to calculate the total N,P, and K uptake at harvest and was expressed as kg ha⁻¹. Serial dilution plate technique was used for isolation and enumeration of soil fungi, actinomycetes and bacteria as described by Pahwa and Prakash (1996).

RESULTS AND DISCUSSION

Nutrients uptake by crop

The data presented in Table 1 showed that there was a significant differences in uptake of major nutrients N, P and K. Maximum total

nitrogen, phosphorus and potassium uptake of 268.11, 39.76 and 148.69 kg ha⁻¹ respectively was recorded in weed free treatment (T₁₁) followed by Atrazine 0.50kg/ha fb tembotrione 0.120 kg/ha (264.40, 39.14 and 146.17 NPK kg ha⁻¹) and treatment Atrazine 0.50 kg/ha fb 2,4-D sodium salt @ 0.5kg/ha (T₇). The result showed that the NPK uptake by plant was highest in treatment weedy free (T₁₁), it might due to less competition of plant and weeds for nutrient, but in treatment weedy check the rate of uptake of NPK by plants was very slow where N,P,K uptake was only 182.45 , 24.23, 96.81 NPK kg ha⁻¹. This is due to weed suppress the vegetative growth of maize plants by competition to light, moisture and nutrient. Similar results were also reported by Chalka and Nepalia (2006), Balyan and Kumpawat (2008) and Kour et al. (2014).

Nutrients uptake by weed

Data regarding nitrogen, phosphorous and potassium uptake (kg ha⁻¹) by weeds as influenced by different treatments are presented in Table-1 which clearly indicated that weedy check treatment showed maximum uptake (36.49, 4.88, 24.57 NPK kg ha⁻¹) of major nutrients than all other treatments of chemical herbicides and weed free plots. This was mainly due to heavy infestation of weeds which took up enormous amount of NPK from soil in weedy check as nutrient uptake and which was directly governed by dry matter production of weeds. Among the herbicidal treatments Atrazine 0.50 kg/ha fb tembotrione 0.120 kg/ha(10.95,2.07,7.35 NPK kg ha⁻¹), treatment Atrazine 0.50 kg/ha fb 2,4-D sodium salt @ 0.5kg/ha (T₇) and Atrazine@1 kg a.i/ha (T₁) recorded minimum uptake of nutrients by weeds and was found at par with each other. Mahadevaiah and Karunasagar (2014) also reported that the weedy check registered highest nitrogen, phosphorus and potassium uptake by weeds. This results are also reported earlier by Kour et al. (2014) where maximum removal of N, P and K by weeds was recorded with weedy check due to higher dry matter of weeds which enabled them to absorb more nutrients and further, pre-emergence application of atrazine @ 0.5 kg ha⁻¹

¹ resulted in significantly lower N, P and K uptake by weeds which was followed by post-emergence application of atrazine @ 0.75 kg ha⁻¹.

Effect on soil microflora (Bacteria, Fungi and Actinomycetes)

The effect on different soil microflora viz. bacteria, fungi and actinomycetes due to different weed control treatments was studied and the data is presented in Table-2 which showed that before sowing there were non-significant differences in all the microbial population. There was decrease in population of bacteria after spraying of herbicides. But it was recovered at harvest stage of the crop. Higher count of all this microflora was recorded in weedy check treatment as no chemicals was used in these treatments. However this was comparable with the count as observed in weed free treatments. Effect of herbicides after spraying significantly

influenced the population of soil microorganisms viz., bacteria, fungi and actinomycetes as compared to their population before herbicide application. But at the time of harvest of the crop the microbial population with all the treatments attained the equal level. It might be due to the degradation of herbicides may be serving as carbon source for growth of microbes. The microbial population started to regain after the weeds were killed by the herbicides and got mixed in the soil during this period and these might have served to increase the nutrients. The present study showed that there is a temporary suppression in population of beneficial micro organisms but with passage of time the population again recovered in these biological soil environments. It was in conformity with the results of Pal et al. (2009) and Ghosh et al. (2012), Sebiomo et al. (2011) and Trimurtulu et al. (2015).

Table 1: Nutrients uptake (N,P and K) by crop and weed as influenced by different weed control treatments in maize

Treatments	Total nutrients uptake by crop (Grain + Straw) Kg ha ⁻¹			Nutrients uptake by weed Kg ha ⁻¹		
	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake
T ₁ : Atrazine 1 kg a.i/ha PE	250.07	35.68	134.69	13.78	2.25	7.90
T ₂ : Pendimethalin 1 kg/ha PE	194.28	25.26	102.16	27.85	3.66	10.53
T ₃ : Metribuzin 0.35 kg/ha PE	199.73	26.32	103.99	25.61	3.49	10.23
T ₄ : Atrazine 0.50 kg + Pendimethalin 0.50kg/ha PE	224.65	30.00	110.11	19.65	2.74	8.94
T ₅ : 2,4-D sodium salt @ 0.80 kg/ha POE 30 DAS	219.44	28.18	106.54	21.95	3.15	9.17
T ₆ : Tembotrione 0.120 kg/ha POE 20 DAS	235.16	31.50	116.37	16.55	2.67	8.64
T ₇ : Atrazine 0.50 kg /ha fb 2,4-D sodium salt @ 0.50 kg/ha POE 30 DAS	257.12	37.89	144.61	11.92	2.15	7.68
T ₈ : Atrazine 0.50 kg/ha fb tembotrione 0.120 kg/ha POE 20 DAS	264.40	39.14	146.17	10.95	2.07	7.35
T ₉ : Topramezone 0.0252 kg/ha POE 20 DAS	239.68	33.41	119.46	15.38	2.45	8.12
T ₁₀ : Halosulfuron methyl 0.05 kg/ha POE 20 DAS	206.15	27.06	104.69	24.83	3.25	9.74
T ₁₁ : Weed free	268.11	39.76	148.69	0.00	0.00	0.00
T ₁₂ : Weedy check	182.45	24.23	96.81	36.49	4.88	24.57
SE (M) ±	9.18	1.48	5.15	0.84	0.19	0.62
C. D. at 5 %	26.88	4.33	15.09	2.48	0.57	1.83

Figures in parenthesis are original values

Table 2: Microbial count (Bacteria, Fungi and Actinomycetes) as influenced by different weed control treatments in maize at periodical growth stages

Treatments	Bacteria (cfu g ⁻¹ soil × 10 ⁷)			Fungi (cfu g ⁻¹ soil × 10 ⁴)			Actinomycetes (cfu g ⁻¹ soil × 10 ⁶)		
	Before sowing	After spray	At harvest	Before sowing	After spray	At harvest	Before sowing	After spray	At harvest
T₁ : Atrazine 1 kg a.i/ha PE	27	22	26	20	16	19	22	17	20
T₂ : Pendimethalin 1 kg/ha PE	24	18	22	16	10	13	19	14	18
T₃ : Metribuzin 0.35 kg/ha PE	26	20	23	18	13	16	21	16	19
T₄ : Atrazine 0.50 kg + Pendimethalin 0.50kg/ha PE	26	21	24	19	14	18	21	17	20
T₅ : 2,4-D sodium salt @ 0.80 kg/ha POE 30 DAS	25	22	24	16	14	15	20	17	22
T₆ : Tembotrione 0.120 kg/ha POE 20 DAS	25	23	26	17	15	18	20	18	23
T₇ : Atrazine 0.50 kg /ha fb 2,4-D sodium salt @ 0.50 kg/ha POE 30 DAS	26	23	28	20	16	21	22	20	24
T₈ : Atrazine 0.50 kg/ha fb tembotrione 0.120 kg/ha POE 20 DAS	27	25	29	21	18	23	23	20	26
T₉ : Topramezone 0.0252 kg/ha POE 20 DAS	26	22	27	19	17	20	21	18	23
T₁₀ : Halosulfuron methyl 0.05 kg/ha POE 20DAS	24	21	22	16	13	17	19	16	16
T₁₁ : Weed free	29	30	33	22	24	27	25	27	28
T₁₂ : Weedy check	28	32	34	23	26	28	24	29	24
SE (M) ±	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

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