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Effect of Weed Management and Nutrient Application on Soil Enzyme Activity, pH, EC, Organic Carbon and Available Nutrients in Soil at Harvest of Quality Protein Maize

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A B S T R A C T

A field experiment was conducted during *kharif* and *rabi* seasons of2015-16 and 2016-17 at Udaipur to evaluate the effect of weed and nutrient management on quality protein maize. The experiment consisted of nine weed management treatments *viz*., weedy check, hand weeding at 15 DAS and 35 DAS, tembotrione 0.125 kg ha^{-1} at 20 DAS, alachlor 2 kg ha^{-1} as PE *fb* hand weeding at 35 DAS, atrazine 0.5 kg ha^{-1} as PE*fb* hand weeding at 35 DAS, tembotrione 0.125 kg ha^{-1} at 20 DAS *fb* hand weeding at 35 DAS, alachlor 2 kg ha^{-1} + atrazine 0.5 kg ha^{-1} as PE *fb* hand weeding at 35 DAS, alachlor 2 kg ha^{-1} as PE *fb* tembotrione 0.125 kg ha^{-1} at 20 DAS and atrazine 0.5 kg ha^{-1} as PE *fb* tembotrione 0.125 kg ha^{-1} at 20 DAS with three nutrient management treatments *viz*., NPK, NPK+Zn and NPKS+Zn, thereby making 27 treatment combinations. The experiment was laid out in split plot design, assigning weed management to main plots and nutrient management to sub plots. The treatments were replicated thrice. Maize cv. Pratap QPM-1 used as test crop. Soil enzyme activity, pH, EC and organic carbon at harvest of QPM were found unaffected with various weed and nutrient management treatments. Further, different weed and nutrient management treatments failed to cause any significant effect on available nitrogen, phosphorus, potassium and sulphur nutrients in soil at harvest of QPM.

Introduction

Maize (*Zea mays* L.) also called as the queen of cereals, is one of the major cereal crops with wide adaptability under various diversified agro-climatic edaphic conditions around the world. In this crop, the content of essential amino acids *viz.,* lysine and tryptophan is low while leucine and isoleucine content is high (Jat *et al.,* 2013). The QPM is a hybridized variety of maize specially bread by addition of *Opaque*-2 mutant gene, which improve lysine and tryptophan and reduce leucine and isoleucine contents and produce quality protein with balanced composition of amino acids.

Major area of maize in India is during *kharif* season in which weed is one of the most important yield limiting factor and

significantly reduces the yield. Maize is infested by a wide range of weed flora, *viz.*, *Echinochloa colona, Cyperusrotundus, Cynodon dactylon, Commelina benghalensis, Digera arvensis and Trianthema portulacastrum* dominate during early stages of the crop growth and toward the tasseling and maturity of the crop. However, the most critical period for crop weed competition are first six weeks after planting of crop which may reduce yield by 28-100% (Dass *et al.,* 2012). During this critical period weeding is essentially required by either chemical or non-chemical means. Weeding by hands (labour) and mechanical means are expensive and many a times timely operations are not possible due to continuous rains in monsoon season. However, application of single herbicide does not provide satisfactory weed control for the desired period. Atrazine and alachlor have been widely recommended for effective control of weeds in maize (Tahir *et al.,* 2011). Atrazine, recommended as a pre-emergence herbicide, is not effective against some of the weeds, both grassy and non-grassy as well as the sedge *Cyperus rotundus* (Singh *et al.,* 2015). Hence, there is need for some alternate post-emergence herbicide like tembotrione which can provide broad spectrum weed control in *kharif* maize without affecting the crop growth and yield of crop (Singh *et al.,* 2012 b). Nutrient management also plays key role in sustaining the productivity of this system, QPM is high nutrient requiring ones and respond well to higher levels of chemical fertilizers. Quality protein maize is a nitrogen exhaustive crop and requires very high dose of the nutrient (Singh, 2010 and Om *et al.,* 2014). Thus higher yield of QPM can be obtained through the judicious and higher uses of two major nutrients (N and P) as these two nutrients alone contribute 40-60 per cent of the crop yield (Das *et al.,* 2010). Among the secondary and micronutrients, S and Zn have also a specific vital role in growth and development of crops (Duraisami *et al.,* 2007). It is proven fact that productivity of any crop cannot be further increased by use of high doses of fertilizer alone. So the nutrient management with balanced use of nutrients increases the yield and also maintains soil health.

Materials and Methods

A field experiment was conducted during *kharif* and *rabi* seasons of2015-16 and 2016-17 at Instructional Farm (Agronomy), Rajasthan College of Agriculture, Udaipur. The site is situated at South-Eastern part of Rajasthan at an altitude of 579.5 metre above mean sea level with 24º35' N latitude and 74°42' E longitude. The region falls under agro-climatic zone IVa (Sub-Humid Southern Plain and Aravalli Hills) of Rajasthan. This zone possesses a typical sub-tropical climatic conditions characterized by mild winters and moderate summers associated with high relative humidity. The mean annual rainfall of the region is 637 mm. Soil of experimental site was clay loam in texture and slightly alkaline in reaction (pH 8.1 and 8.0) and medium in available nitrogen (285.0 and 279.61 kg ha^{-1}) and phosphorus (20.42 and 19.27 kg ha^{-1}) and high in available potassium (324.16 and 318.15 kg ha^{-1}) and low in available sulphur (9.7 and 9.3 kg ha^{-1}) during both the years *i.e.,* 2015-16 and 2016-17, respectively. The experiment consisted of nine weed management treatments *viz*., weedy check, hand weeding at 15 DAS and 35 DAS, tembotrione 0.125 kg ha^{-1} at 20 DAS, alachlor 2 kg ha^{-1} as PE *fb* hand weeding at 35 DAS, atrazine 0.5 kg ha^{-1} as PE*fb* hand weeding at 35 DAS, tembotrione 0.125 kg ha^{-1} at 20 DAS *fb* hand weeding at 35 DAS, alachlor 2 kg ha^{-1} + atrazine 0.5 kg ha^{-1} as PE *fb* hand weeding at 35 DAS, alachlor 2 kg ha^{-1} as PE *fb* tembotrione 0.125 kg ha^{-1} at 20 DAS and atrazine 0.5 kg ha^{-1} as PE *fb* tembotrione 0.125 kg ha^{-1} at 20 DAS with three nutrient management treatments *viz*., NPK, NPK+Zn

and NPKS+Zn, thereby making 27 treatment combinations. The experiment was laid out in split plot design, assigning weed management to main plots and nutrient management to sub plots. The treatments were replicated thrice. Maize cv. Pratap QPM-1 was used as test crop, sown at the seed rate of 20 kg ha^{-1} at inter row of 60 and plant to plant spacing of 25 cm. Furrows were opened through desi plough and seeds were sown manually at the depth of 5 cm. As per the treatment full dose of phosphorus, potash, sulphur and zinc and half dose of nitrogen were applied at sowing by drilling in crop rows through urea, DAP, mineral gypsum and zinc sulphate. The remaining dose of nitrogen was top dressed at knee height stage through urea. As per treatment, both atrazine and alachlor were sprayed one day after sowing (as pre-emergence) while tembotrione was applied twenty days after sowing (as post-emergence) with knapsack sprayer. Random soil samples were drawn at two different locations from each plot up to 15 cm depth after harvest of the crop. These were air dried and pass through 2 mm sieve and analyzed for pH, EC, organic carbon, available N, P, Kand S, Dehydrogenase, Phosphatase and Urease enzyme activity as per analysis method.

Results and Discussion

Effect on soil

Soil enzyme activity viz., Dehydrogenase, Phosphotase and Urease as well as soil pH, EC and organic carbon at harvest of QPM were found unaffected with various weed and nutrient management treatments.

Table.1 Effect of weed management and nutrient application on soil enzyme activity, pH and EC at harvest of QPM (pooled data of 2 years)

Treatments	Dehydrogenase enzyme activity (µg g^{-1} h^{-1})	Phosphatase enzyme activity (µg g^{-1} h^{-1})	Urease enzyme activity (µg g^{-1} h^{-1})	Soil pH	Soil EC (dsm^{-1})
Weed management					
Weedy check	122.78	207.57	336.80	8.19	**0.844**
Hand weeding 15 & 35 DAS	138.23	227.96	365.14	8.27	**0.880**
Tembotrione	124.67	212.30	331.41	8.22	**0.855**
Alachlor*fb*hand weeding	127.53	211.04	337.18	8.22	**0.845**
Atrazine *fb*hand weeding	129.09	183.61	341.80	8.22	**0.855**
Tembotrione*fb*hand weeding	130.82	222.30	346.72	8.22	**0.855**
Alachlor+atrazine*fb*hand weeding	131.90	205.06	351.93	8.25	**0.860**
Alachlor*fb*Tembotrione	136.91	221.69	356.57	8.26	**0.870**
Atrazine *fb*Tembotrione	140.18	226.97	365.86	8.27	**0.880**
S.Em. ±	4.23	7.46	10.68	0.05	**0.011**
C.D. (P = 0.05)	NS	NS	NS	NS	**NS**
Nutrient management					
NPK	129.86	212.24	345.36	8.24	**0.859**
NPK+Zn	130.84	212.44	348.42	8.24	**0.861**
NPKS+Zn	133.34	214.82	350.69	8.24	**0.862**
S.Em.±	1.58	1.81	3.70	0.02	**0.004**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

Table.2 Residual effect of weed management and nutrient application on soil organic carbon and available nutrients at harvest of QPM (pooled data of 2 years)

Treatments	Organic carbon (g kg^{-1})	Available Nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})	Available Sulphur (kg ha^{-1})
Weed management					
Weedy check	7.79	304.21	21.76	486.68	**19.97**
Hand weeding 15 & 35 DAS	7.58	333.84	24.14	541.42	**22.16**
Tembotrione	6.92	327.05	21.13	533.55	**19.84**
Alachlor*fb*hand weeding	6.92	328.08	21.19	534.92	**20.66**
Atrazine *fb*hand weeding	6.95	329.10	21.37	535.88	**21.42**
Tembotrione*fb*hand weeding	6.93	326.63	21.83	534.71	**20.11**
Alachlor+atrazine*fb*hand weeding	7.36	330.83	22.09	537.52	**22.51**
Alachlor*fb*Tembotrione	7.56	329.05	22.87	540.52	**22.05**
Atrazine *fb*Tembotrione	7.59	335.62	24.97	549.64	**22.24**
S.Em. ±	0.19	7.18	0.81	12.72	**0.56**
C.D. (P = 0.05)	NS	NS	NS	NS	**NS**
Nutrient management					
NPK	7.27	326.41	22.35	532.07	**21.07**
NPK+Zn	7.31	327.04	22.39	532.61	**21.21**
NPKS+Zn	7.29	328.03	22.38	533.61	**21.37**
S.Em.±	0.07	2.20	0.17	3.84	**0.17**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

Further, different weed and nutrient management treatments failed to cause any significant effect on available nitrogen, phosphorus, potassium and sulphur nutrients in soil at harvest of QPM.

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