

Effect of weed and nutrient management on nutrient uptake by maize (*Zea mays*) and weeds

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ABSTRACT

The results of field experiment carried out during the rainy seasons of 1997 and 1998 at Instructional Farm, Rajasthan College of Agriculture, Udaipur, indicated that adoption of various weed-management treatments significantly enhanced N and P uptake by maize (*Zea mays* L.) and reduced removal of nutrients by weeds as compared to weedy check. Maximum saving of 30.1% nitrogen and 26.4% phosphorus was achieved with atrazine at 0.5 kg/ha as pre-emergence + intercultivation at 35 days after sowing (DAS). This treatment gave 92.7 and 57.4% more grain and stover yield, respectively, on pooled basis compared to weedy check, which was followed by intercultivation twice at 20 and 35 DAS. The yield as well as uptake of N and P by the crop were maximum with 150% recommended dose of N and P through fertilizer, followed by 125% recommended dose of fertilizer while the uptake of N and P were comparatively higher with the treatments involving application of FYM 10 tonnes/ha compared to remaining treatment of nutrient management.

Key words : Weed management, Nutrient management, Maize, FYM, Nutrient uptake

Maize is an important cereal crop of Rajasthan during rainy season. The poor productivity of maize is mainly because of inadequate attention towards weed and nutrient management. It is well known fact that weeds through competition with crop, deprive crops of limited essential resources prominent amongst which are nutrients.

Moreover, weeds grow faster than the crop plants and absorb the nutrients earlier resulting into lack of nutrient for the growth of crop plants. Thus, nutrients drain by weeds assumes added significance in the present context of fertilizer crisis. Control of weeds is vitally important not only to check the yield losses caused by them but also to

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increase the fertilizer use efficiency. The present investigation was therefore undertaken to study the extent of nutrient depletion by crop and weeds under various weed and nutrient-management systems and to minimize these losses by controlling weeds.

MATERIALS AND METHODS

The experiment was conducted at Instructional Farm, Rajasthan College of Agricultural, Udaipur, during the rainy seasons of 1997 and 1998. The experimental soil was clay loam, alkaline, medium in available nitrogen and phosphorus and high in potassium. The experiment consisted of 6 weed-management treatments, viz. weedy check (W_0), intercultivation twice at 20 and 35 days after sowing (DAS) (W_1), atrazine at 0.5 kg/ha as pre-emergence (W_2), glyphosate at 0.5 kg/ha at 21 DAS (W_3), atrazine at 0.5 kg/ha as pre-emergence + intercultivation at 35 DAS (W_4), and atrazine at 0.5 kg/ha as pre-emergence followed by glyphosate at 0.5 kg/ha at 21 DAS (W_5) in main plots; and 5 nutrient-management treatment, viz. 100% recommended dose of N and P through fertilizer (F_1), 125% recommended dose of N and P through fertilizer (F_2), 150% recommended dose of N and P through fertilizer (F_3), 100% recommended dose of N and P through FYM 10 tonnes/ha and fertilizer (F_4) and 100% recommended dose of N and P through fertilizer + FYM 10 tonnes/ha in subplots. The experiment was laid out in split-plot design with 4 replications. Maize variety 'Navjot' was sown at 60 cm row spacing using 25 kg

seed/ha on 8 and 2 July and harvested on 18 and 14 October in respective seasons. Application of 90 kg N and 35 kg P_2O_5 /ha was done through urea and single superphosphate, respectively, as recommended dose of fertilizer. As per treatment whole quantity of phosphorus and one-third nitrogen were applied at sowing and remaining was applied in 2 splits each at knee-high and tasseling stage. The size of the gross and net plots were 5.0 m $\times$ 3.6 m and 4.0 m $\times$ 2.4 m respectively. Total rainfall in the respective seasons during the crop period was 483.9 mm and 470.4 mm. Life-saving irrigations were also applied as and when needed. As per treatment, atrazine was applied the next day of sowing, while glyphosate at 21 DAS as directed spray between inter-rows and intercultivation as per treatment was done at 20 and 35 DAS with hand-hoe (*kudali*). Well-rotten FYM was incorporated into the soil few days before sowing in the respective plots. Yield data on crops and dry weight of weeds were recorded at harvest.

RESULTS AND DISCUSSION

Important weed flora during the study period that constituted monocot weeds were *Echinochloa colonum* (L.) Link, *Cynodon dactylon* (L.) Pers. and *Cyperus rotundus* L., while dicot weeds were *Trianthema portulacastrum* L., *Commelina benghalensis* L., *Amaranthus spinosus* L., *Digera muricata* L. and *Parthenium hysterophorus* L. Out of these, *Echinochloa colonum* and *Trianthema portulacastrum* were the most dominant monocot and dicot weeds respectively.

Dry matter of weeds

Pooled data (Table 1) revealed that all the weed-management treatments significantly reduced dry weight of monocot, dicot and total dry weight of weeds compared to weedy check. The minimum total weed dry weight (8.4 q/ha) was observed under atrazine at 0.5 kg/ha as pre-emergence + intercultivation at 35 days after sowing (DAS), followed by intercultivation at 20 and 35 DAS (8.8 q/ha), while the maximum total dry weight (34.6 q/ha) was recorded in weedy check. Moreover, both these treatments (W_1 and W_4) were found significantly superior to rest of the weed-control treatments in

reducing the total dry weight of weeds. The superiority of these treatments (W_1 and W_4) in controlling weeds to rest ones was because of the fact that in case of W_4 early growth of weeds was checked by atrazine, a versatile pre-emergence herbicide which is readily absorbed by weeds, while in case of W_1 it was checked by intercultivation performed at 20 DAS and later on in both these treatments late-emerging weeds were effectively controlled by intercultivation which was done at 35 DAS. Amongst the various nutrient-management treatments, FYM involving treatments (F_4 and F_5) resulted in significant increase in monocot as well as total weed dry weight (Table 1)

Table 1. Effect of weed and nutrient management on dry matter of weeds and nutrient removal by them at harvest (pooled data of two years)

Treatment	Weed dry matter (q/ha)			Nutrient removal by weeds (kg/ha)					
	Monocot	Dicot	Total	Nitrogen			Phosphorus		
				Monocot	Dicot	Total	Monocot	Dicot	Total
<i>Weed management</i>									
Weedy check	19.5	15.1	34.6	28.8	26.0	54.7	5.1	4.4	9.6
IC at 20 and 35 DAS	5.9	3.0	8.8	8.8	5.3	14.1	1.6	0.9	2.5
Atrazine 0.5 kg/ha	11.6	3.4	14.9	17.3	6.1	23.4	3.1	1.0	4.1
Glyphosate 0.5 kg/ha	17.1	12.8	29.9	25.5	22.3	47.8	4.5	3.8	8.3
Atrazine 0.5 kg/ha + IC at 35 DAS	6.0	2.4	8.4	9.2	4.3	13.5	1.6	0.7	2.4
Atrazine 0.5 kg/ha + glyphosate 0.5 kg/ha	10.6	3.1	13.7	16.1	5.4	21.5	2.8	0.9	3.7
CD (P=0.05)	0.79	0.47	1.10	1.36	1.08	2.11	0.21	0.16	0.34
<i>Nutrient management</i>									
100% NP (fertilizer)	11.2	6.3	17.5	16.5	11.0	27.4	3.0	1.9	4.8
125% NP (fertilizer)	11.5	6.5	18.0	17.3	11.4	28.7	3.1	1.9	5.0
150% NP (fertilizer)	11.7	6.6	18.3	17.8	11.7	29.4	3.2	2.0	5.1
100% NP (FYM10 tonnes/ ha and fertilizer)	12.2	6.8	18.9	18.0	11.7	30.0	3.2	2.0	5.2
100% NP (fertilizer + FYM) 10 tonnes/ha)	12.4	6.9	19.2	18.6	12.0	30.5	3.3	2.0	5.3
CD (P=0.05)	0.58	NS	0.86	0.90	NS	1.41	0.16	NS	0.25

compared to 100% recommended dose of N and P through fertilizer. The maximum total weed dry weight of 19.2 q/ha was recorded under F_5 compared with the lowest of 17.5 q/ha under F_1 . Significant increase in weed dry weight with these treatments may be due to the fact that FYM may contain weeds of certain species and infested the crop with weeds and might have supplied additional nutrients to the weeds which resulted into increased dry matter of various weeds. Results corroborate with the findings of Mehta *et al.* (1995).

Grain, stover and biological yield

All the weed-management treatments significantly increased grain, stover and

biological yields compared with weedy check on pooled basis (Table 2). The pronounced effect of increased yield was observed with atrazine at 0.5 kg/ha as pre-emergence + intercultivation at 35 DAS. This resulted in increase in grain, stover and biological yields by 92.7, 57.4 and 67.1%, respectively, compared to their corresponding weedy check treatments. However, this treatments was closely followed by intercultivation twice at 20 and 35 DAS (W_1). The increase in yield under various weed-management treatments may be attributed to significant reduction in weed dry matter (Table 1), thereby, reduction in crop-weed competition which provided congenial environment to the crop

Table 2. Effect of weed and nutrient management on yield and nutrient removal by maize (pooled data of 2 years)

Treatment	Yield (q/ha)			Nutrient removal (kg/ha)					
	Grain	Stover	Biological	Nitrogen			Phosphorus		
				Grain	Stover	Total	Grain	Stover	Total
<i>Weed management</i>									
Weedy check	23.2	61.0	84.2	40.2	46.5	86.7	9.3	9.8	19.1
IC at 20 & 35 DAS	43.4	94.7	138.1	72.6	69.0	141.6	16.9	14.6	31.5
Atrazine 0.5 kg/ha	37.3	85.5	122.9	63.8	64.0	127.7	14.8	13.3	28.1
Glyphosate 0.5 kg/ha	27.9	71.0	98.9	48.1	53.9	101.9	10.9	11.2	22.1
Atrazine 0.5 kg/ha + IC	44.7	96.0	140.7	74.0	69.9	143.9	17.3	14.7	32.0
Atrazine 0.5 kg/ha + glyphosate + 0.5 kg/ha	39.6	88.7	128.3	67.5	65.3	132.7	15.6	13.8	29.4
CD (P=0.05)	2.51	5.63	6.65	4.42	4.68	6.96	0.94	1.05	1.50
<i>Nutrient management</i>									
100% NP (fertilizer)	33.4	77.6	111.1	56.5	57.2	113.7	13.0	12.0	25.0
125% NP (fertilizer)	37.0	84.8	121.8	62.9	63.1	126.0	14.5	13.2	27.8
150% NP (fertilizer)	39.2	89.0	128.1	67.1	66.9	134.0	15.5	14.1	29.6
100% NP (FYM 10 tonnes/ha and fertilizer)	34.5	79.9	114.4	57.9	58.5	116.3	13.4	12.3	25.7
100% NP (fertilizer + FYM 10 tonnes/ha)	36.0	82.8	118.8	60.7	61.5	122.2	14.2	12.9	27.1
CD (P=0.05)	1.61	3.71	4.17	2.82	2.90	4.22	0.67	0.65	0.99

for better expression of vegetative and reproductive potential. Application of 150% recommended dose of N and P through fertilizer gave significantly higher grain, stover and biological yields compared to the rest of treatments. The respective increase in grain, stover and biological yield under F_3 was 17.4, 14.7 and 15.3% compared to the lowest yield levels as recorded under 100% recommended dose of N and P through fertilizer. Higher fertility levels might have increased availability of nutrients in the soil which culminated into more absorption and higher uptake of nutrients by the crop plants and led to better plant growth. The favourable effect of yield may also be due to lesser competition for nutrient between crop and weeds under higher fertility levels. Results obtained under increased nutrition corroborate with the findings of Angiras and Singh (1988).

Nutrient uptake by crop

All the weed-management treatments significantly enhanced N and P uptake by grain, stover as well as total uptake of these nutrients by the crop over weedy check (Table 2). The highest N and P uptake by the grain (74.0 and 17.3 kg/ha), stover (69.9 and 14.7 kg/ha) and total uptake (143.9 and 32.0 kg/ha) by the crop was recorded with atrazine at 0.5 kg/ha as pre-emergence + intercultivation at 35 DAS, followed by intercultivation at 20 and 35 DAS which might be ascribed to higher weed-control efficiency with these treatments resulting in more favourable environment for growth and development of crop plants. The results confirm the findings of Sreenivas and

Satyanarayana (1996). All the treatments of nutrient management except 100% NP through FYM 10 tonnes/ha and fertilizer (F_4) were found significant in enhancing grain, stover and total uptake of N and P by the crop compared to F_1 (Table 2). The highest total uptake of nitrogen (134.0 kg/ha) and phosphorus (29.6 kg/ha) were recorded under F_3 compared with lowest (113.7 and 25.0 kg/ha respectively) recorded under F_1 treatment. The nutrient uptake by the crop is mainly the function of crop yield. Therefore, considerable increase in N and P uptake was attributed to higher grain and stover yields at higher fertility levels. The results are in close conformity with the findings of Khanday and Thakur (1991).

Nutrient removal by weeds

All the weed-management treatments significantly minimized the nutrient removal by monocot and total uptake by weeds compared to weedy check. The minimum removal of total N (13.5 kg/ha) and P (2.4 kg/ha) by weeds were observed in W_4 treatment which was followed by W_1 (Table 1), while the maximum total removal of nutrient (54.7 kg N and 9.6 kg P/ha) was observed under weedy check. Significantly higher removal of N and P by monocot and total uptake by weeds were observed under F_3 , F_4 and F_5 compared to F_1 . Considerable removal of nutrients by weeds under weedy check was also reported by Sreenivas and Satyanarayana (1996). The uptake of N and P by weeds was estimated as 38.7 and 33.4%, respectively, of the total removal (weed + crop) in weedy check and only 8.6 and

7.0% in W_4 and 9.1 and 7.4% in W_1 treatment, thus saving of 30.1% N and 26.4% P could be obtained by the adoption of treatment W_4 while the respective saving of these nutrients under W_1 was 29.6 and 26.0%. Results so obtained are in close confirmity with findings of Thakur *et al.* (1990).

The uptake of N and P by the crop and weeds could be mainly attributed to the extent of their dry-matter production. It is apparent from Tables 1 and 2 that whenever the removal of nutrients by weeds was more, corresponding uptake by the crop was less and vice-versa. Therefore, for efficient utilization of applied nutrients the weed should be kept under control.

REFERENCES

- Angiras, N.N. and Singh, C.M. 1988. Influence of weed control methods, plant population, fertility levels and cropping system on weed management in maize. *Indian Journal Weed Science* **20** (3) : 67-72.
- Khanday, B.A. and Thakur, R.C. 1991. Influence of nitrogen, farm yard manure and zinc on nutrient uptake of early composite maize (*Zea mays* L.) under rainfed condition. *Himachal Journal of Agriculture Research* **17** (1 and 2) : 4-7.
- Mehta, H.M., Trivedi, G.C. and Patel, H.R. 1985. Effect of farm yard manure, fertilizer and herbicides at different levels of their application on weed control and yield of maize. (In) *Abstracts of Papers Annual Conference of Indian Society of Weed Science*, pp. 28-29.
- Rai, M. 2000. Productivity gains in focus. *The Hindu Survey of Indian Agriculture* pp. 53-55.
- Sreenivas, G. and Satyanarayana, V. 1996. Nutrient removal by weeds and maize (*Zea mays* L.). *Indian Journal of Agronomy* **41**(1) : 160-162.
- Thakur, D.R., Singh, K.K. and Thakur, R.C. 1990. Effect of weed and fertilizer management on nutrient uptake by weeds and maize (*Zea mays* L.) under rainfed conditions. *Indian Journal of Agronomy* **35**(4) : 357-360.