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Research Paper

Effect of fertility levels, nutrient sources and weed control on weed dynamics and yield of quality protein maize (*Zea mays*) and relative nitrogen and phosphorus uptake

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ABSTRACT

A field experiment was laid out during the rainy seasons of 2008 and 2009 at Udaipur, Rajasthan, to evaluate effect of fertility levels, nutrient sources and weed control on productivity of quality protein maize (*Zea mays* L.). Twenty seven treatment combinations comprising 3 fertility levels (90 kg N + 40 kg P_2O_5, 120 kg N + 50 kg P_2O_5 and 150 kg N + 60 kg P_2O_5/ha), 3 nutrient sources (100% NP through fertilizers, 75% NP through fertilizers + 25% through vermicompost and 50% NP through fertilizers + 50% through vermicompost) and 3 weed-control measures (weedy check, metribuzin 0.4 kg/ha followed by (fb) hoeing and weeding and atrazine 0.4 kg + alachlor 2.0 kg/ha fb hoeing and weeding) were tested in split-plot block design with 3 replications. Weed density was not affected by fertility levels but the total weed dry matter increased significantly up to 120 kg N + 50 kg P_2O_5/ha at 30 days after sowing (DAS) and up to 150 N + 60 kg P_2O_5/ha at 60 DAS. Significantly higher cobs/plant (1.178), and grains/row (37.8) were produced by raising fertility level up to 120 kg N + 50 kg P_2O_5/ha, whereas grain weight/cob (80.41 g) and 1,000-grain weight (219.58 g) were significantly increased by applying 150 kg N + 60 kg P_2O_5/ha. Significantly higher grain yield (4.18 t/ha) and net returns (₹34.89 $\times 10^3$/ha) and benefit: cost ratio (1.88) were obtained under 120 kg N + 50 kg P_2O_5/ha. Application of 100% NP through fertilizers resulted in significantly higher weed dry matter at 30 and 60 days, yield attributes, grain yield (4.08 t/ha), net returns (₹36.19 $\times 10^3$/ha) and benefit: cost ratio (2.19). Application of pre-emergence atrazine + alachlor followed by hoeing and weeding gave the minimum weed density and dry-matter at 30 and 60 DAS. It also resulted in significantly higher yield attributes, yield (4.48 t/ha) and net returns (₹23.34 $\times 10^3$/ha).

Key words : Fertility levels, Herbicides, Nutrient uptake, Productivity, Quality protein maize

Maize is one of the most versatile promising crops having wider adaptability under varied agro-climatic conditions. It is also playing an important role in the crop diversification strategy of various states of India to look beyond paddy, which consumes huge amount of water, fertilizer and power. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products. Several million people in the developing world consume maize as a staple food and derive their protein and calorie requirements from it. Development of Quality Protein Maize (QPM) through genetic manipulations for improved essential amino acids, viz. lysine and tryptophan, brought about revolution to achieve nutritional security over and above food security (Prasanna, 2012). As heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. Therefore, it needs fertile soil to express its yield potential. Low soil fertility is one of the bottlenecks to sustain agricultural production and productivity. Anthropogenic factors such as inappropriate land-use systems, monocropping, nutrient mining and inadequate supply of nutrients have aggravated the situation. Of the several inputs essential for crop production, the importance of fertilizers is next only to water. Therefore, application of ample quantities of plant nutrients is a key aspect of increasing maize productivity. To alleviate the problem, integrated nutrient management is an option as it utilizes available organic and inorganic nutrients to build ecologically sound and economically viable system (Hargilas, 2012). Intensive cultivation, growing of exhaustive crops, use of unbalanced and inadequate fertilizers accompanied by restricted use of organic manures have made the soils not only deficient in the nutrients, but also

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deteriorated the soil health resulting in decline of crop response to recommended dose of nitrogenous fertilizer. Under such a situation, integrated nutrient management has assumed a great importance and has vital significance for the maintenance of soil productivity. Organic manures, particularly vermicompost, not only supplies macronutrients but also the micronutrients, besides improving soil health. The conjunctive use of chemical fertilizers and vermicompost can augment the nutrient-use efficiency and also enhance the productivity of quality protein maize. Another constraint responsible for poor maize harvests during rainy season is weeds. Their presence not only robs away major share of nutrient pools but also compete with crop for moisture, particularly during the spells of insufficient rains. Luxuriant weed growth also limits penetration of solar radiation in the canopy, resulting in poor photosynthesis which severely affects the growth rate of maize crop. In the absence of appropriate crop-management practices, weed damage to the maize crop may be as high as 50–75% (Joshi *et al*., 2005). Since maize is grown in rainy season, total dependence on manual or mechanical weeding at predetermined times is many times not feasible as it may coincide with showers. Therefore, use of pre-emergence herbicide followed by manual weeding can provide best option for weed suppression. Also herbicide combinations can be more useful for wide- spectrum weed control (Mahadi, 2014). Considering these facts, a field experiment was carried out to evaluate the effect of fertility levels, nutrient sources and weed management on productivity of quality-protein maize.

MATERIALS AND METHODS

The experiment was laid out during the rainy seasons of 2008 and 2009 at Instructional Agronomy Farm, Rajasthan College of Agriculture, Udaipur (24°.35' N, 74°.42' E, 579.5 m above mean sea-level). It represents Sub-Humid Southern Plain and Aravalli Hills zone of Rajasthan. The soil was clay loam in texture and alkaline in reaction (*p*H 8.0 and 8.1). It was medium in available nitrogen (274.6 and 279.6 kg/ha) and phosphorus (19.3 and 18.7 kg/ha) and high in available potassium (318.8 and 324.2 kg/ha) during 2008 and 2009, respectively. Twenty seven treatment combinations comprising 3 fertility levels (90 kg N + 40 kg P_2O_5, 120 kg N + 50 kg P_2O_5 and 150 kg N + 60 kg P_2O_5/ha), 3 nutrient sources (100% NP through fertilizers, 75% NP through fertilizers + 25% through vermicompost and 50% NP through fertilizers + 50% through vermicompost) and 3 weed-control measures (weedy check, metribuzin 0.4 kg/ha followed by (fb) hoeing and weeding (HW) at 30 days after sowing (DAS) and atrazine 0.4 kg + alachlor 2.0 kg/ha followed by HW at 30 DAS) were tested in split-plot design and replicated thrice with fertility levels and nutrient sources in main plots and weed control in sub-plots. Half dose of N and full dose of P_2O_5 (as per treatment) were given as basal application by drilling the desired quantities of urea and diammonium phosphate DAP in crop rows at about 5 cm below the seedling depth. Remaining 50% N was top-dressed through urea at knee height stage. The QPM variety 'HQPM 1' was sown in furrows opened at a row spacing of 60 cm using 20 kg/ha seed rate which was treated with bavistin at 2 g/kg and placed at a depth of about 4–5 cm. The herbicides (as per treatment) were sprayed 2 DAS as pre-emergence spray while hoeing and weeding were performed 30 DAS. Herbicides were sprayed with the help of knapsac sprayer having flat-fan nozzle using 500 litres of water/ha. Thinning was done 15 DAS to maintain plant-to-plant distance of 25 cm. The crop was harvested at full physiological maturity. Observations on weed density were recorded from 0.5 m^2 quadrate at 2 places in the net plot and converted into density/m^2. The data were subjected to transformation to normalize their distribution. Later these samples were dried at 70°C till a constant weight was obtained. The dry matter was then computed in terms of g/m^2. The dried weed and crop grain and stover samples were subjected to nitrogen and phosphorus content as per standard procedure (Prasad *et al.*, 2006). The uptake of N and P by weed was worked out by multiplying their content with dry matter. However, for uptake by crop, the content in grain/ stover was multiplied by yield, respectively, and the total uptake was computed by summing up the uptakes by grain and stover. The economic analysis was done on the basis of prevailing market prices of inputs and output obtained from each treatment.

RESULTS AND DISCUSSION

Density and dry weight of weeds

The field was infested with monocot weeds, viz. *Eichnochloa colonum* (L.) Link, *E. crus-galli* (L.) Beauv. and *Cynodon dactylon* (L.) Pers. and dicot weeds, viz. *Digera arvensis* Forsk., *Phyllanthus niruri* Hook f., *Trianthema potulacstrum* L., *Amaranthus viridis* L., *Commelina benghalensis* L., *Portulaca oleracea* L. and *Parthenium hysterophorus* L.

The density of monocot, dicot and total weeds 30 and 60 days after sowing was not affected significantly by fertility levels and nutrient sources. Application of pre-emergence herbicides followed by hoeing and weeding at 30 days resulted in significant reduction in weed density. The lowest density of monocot and dicot weeds at 30 and 60 DAS was observed in fields treated with atrazine + alachlor followed by hoeing and weeding which was significantly superior to metribuzin followed by hoeing and weeding. In comparison to weedy check, weed control by atrazine + alachlor followed by hoeing and weeding resulted n 84.1 and 77.3% reduction in total weed density at 30 and 60 days, respectively. Its results were significantly superior to metribuzin followed by hoeing and weeding, which accounted for 80.5 and 73.0% reduction at corresponding stages. The minimum dry-matter of monocot and dicot weeds was obtained under-lowest fertility level (90 kg N + 40 kg P_2O_5/ha). Significant increase in monocot and dicot weed dry matter was recorded by raising fertility level beyond 90 kg N + 40 kg P_2O_5/ha. The pooled data of 2 years revealed that at 30 and 60 days, the lowest total weed dry matter was recorded with 90 kg N + 40 kg P_2O_5/ha which was significantly lower than that with higher fertility levels. Though application of fertilizers did not affect the germination status of weeds but increasing level of fertility provided greater amount of nutrients to weeds which might have resulted in higher dry-matter accumulation by them. Mundra *et al*. (2002) also reported liner increase in weed dry matter with increasing NP levels.

Amongst the nutrient sources, application of 50% NP through fertilizers and 50% through vermicompost showed the lowest monocot weed dry-matter, while 100% NP application by fertilizers resulted in the highest dry-matter accumulation. Amongst the nutrient sources, at 30 and 60 days, the minimum total weed dry matter was achieved by applying fertilizers and vermicompost in 50:50 proportion which was 20.1 and 9.9% lesser than that produced by applying 100% NP by fertilizers. Khokhar and Nepalia (2010) also reported variation in weed dry-matter by applying fertilizers and vermicompost.

In comparison to weedy check, both the weed-control treatments resulted in significant reduction in dry-matter monocot and dicot weed at 30 and 60 days but atrazine + alachlor followed by hoeing and weeding was significantly superior to metribuzin followed by hoeing and weeding. Total weeds revealed 85.4 and 81.1 and 76.4 and 72.7% reduction in dry-matter at 30 and 60 days by applying atrazine + alachlor followed by hoeing and weeding and metribuzin followed by hoeing and weeding respectively. The results of former were significantly superior to the later. Conjoint application of atrazine and alachlor was more effective in reducing weed density and dry matter because of possible synergism between the 2 which was responsible for the control of wide range of monocot as well as dicot weeds (Mahadi, 2014). The results confirm the findings of

Table 1. Effect of fertility levels, nutrient sources and weed control on weed dynamics (pooled data of 2 years)

Treatment	Weed density (Nos./m^2)*						Weed dry matter (g/m^2)					
	30 DAS			60 DAS			30 DAS			60 DAS		
	Monocot	Dicot	Total	Monocot	Dicot	Total	Monocot	Dicot	Total	Monocot	Dicot	Total
Fertility levels (N + P_2O_5 kg/ha)												
90 + 40	5.98 (41.3)	5.19 (32.8)	7.90 (74.2)	6.66 (49.7)	6.55(47.1)	9.32(96.8)	30.11	30.41	60.52	135.31	141.36	276.67
120 + 50	6.06 (42.4)	5.21 (33.2)	7.98 (75.6)	6.68 (49.9)	6.47(46.7)	9.27(96.6)	33.95	33.22	67.17	151.90	157.97	309.87
150 + 60	6.00 (42.2)	5.15 (32.8)	7.89 (75.0)	6.60 (49.6)	6.45(46.4)	9.21(96.0)	36.42	34.70	71.11	154.64	160.46	315.10
SEm±	0.08	0.07	0.07	0.08	0.06	0.07	0.65	0.55	0.93	2.39	2.41	4.76
CD (P=0.05)	NS	NS	NS	NS	NS	NS	1.88	1.58	2.67	6.88	6.93	13.71
Nutrient sources												
100% fertilizers (F)	6.07 (42.6)	5.29 (33.8)	8.04 (76.4)	6.71(50.6)	6.61(48.5)	9.40(99.1)	35.60	34.76	70.36	154.99	160.95	315.94
75% F + 25% VC	5.91 (40.8)	5.16 (32.4)	7.82 (73.3)	6.58(49.0)	6.44(46.1)	9.19(95.1)	33.65	32.58	66.23	147.50	153.59	301.09
50 % F + 50% VC	6.05 (42.4)	5.10 (32.6)	7.91 (75.0)	6.64(49.6)	6.42(45.6)	9.22(95.2)	31.32	30.99	62.22	139.35	145.25	284.60
SEm±	0.08	0.07	0.07	0.08	0.06	0.07	0.65	0.55	0.93	2.39	2.41	4.76
CD (P=0.05)	NS	NS	NS	NS	NS	NS	1.88	1.58	2.67	6.88	6.93	13.71
Weed-control												
Weedy check	9.50 (89.9)	8.74 (76.0)	12.90(165.9)	10.06(100.9)	9.63(92.4)	13.92(193.3)	73.41	75.55	148.96	296.54	300.85	597.39
Metribuzin fb H & W	4.45 (19.6)	3.61 (12.7)	5.70(32.3)	5.12(25.9)	5.16(26.3)	7.25(52.2)	15.26	12.93	28.19	77.98	85.11	163.09
Atrazine + alachlor fb H & W	4.08 (16.4)	3.20 (10.1)	5.17(26.4)	4.75(22.4)	4.67(21.5)	6.64(43.9)	11.81	9.85	21.66	67.33	73.83	141.15
SEm±	0.06	0.07	0.07	0.06	0.06	0.06	0.56	0.50	0.83	1.93	2.02	3.92
CD (P=0.05)	0.17	0.18	0.19	0.18	0.16	0.17	1.57	1.41	2.35	5.43	5.70	11.06

*Data subjected to $\sqrt{x+0.05}$ transformation and figures in parentheses are original weed count/m^2

DAS, Days after sowing; VC, vermicompost; F, Fertilizer; H & W, hoeing and weeding; fb, followed by

Choudhary *et al.* (2013).

Yield attributes and yield

The maximum values of all yield attributes were obtained by applying the highest fertility level (150 kg N + 60 kg P_2O_5/ha). However, cobs/plant, and grains/row increased significantly only up to 120 kg N + 50 kg P_2O_5/ha, whereas 1,000-grain weight increased significantly up to 150 kg N + 60 kg P_2O_5/ha. Significant increase (30.3%) in grain yield was associated with the increase in fertility level from 90 kg N + 50 kg P_2O_5/ha to 120 kg N + 50 kg P_2O_5/ha, beyond which the increase in yield was non-significant. Nitrogen and phosphorus play vital role in different plant metabolic activities and in improving nutritional status of plants. Application of 120 kg N + 50 kg P_2O_5/ha might have supplied N and P to the plants to the level of sufficiency that was able to improve yield attributes and finally the yield. The present findings are in close agreement with that of Suthar *et al.* (2014).

Amongst nutrient sources, the yield attributes produced under the effect of 100% NP application through fertilizers were of higher order in comparison to its 25 or 50% substitution with vermicompost, except for cobs/plant and 1,000-grain weight for which 100% fertilizer application was at par with 75% fertilizers + 25% vermicompost. The highest grain yield was obtained by enriching the soil with 100% NP through fertilizers, being 4.0 and 11.3% higher than 75% fertilizers + 25% vermicompost and 50% fertilizers + 50% vermicompost respectively. Application of nutrients exclusively through chemical fertilizers might have offered release of nutrients in synchrony with critical demand period that could be used by crop to produce higher photosynthates which were later translocated to developing sink to produce higher grain yield. The results are in close conformity with those of Nath *et al*. (2009).

The 2 weed-control treatments resulted significantly higher yield attribute values over weedy check. These treatments were at par for cobs/plant and 1,000-grain weight but atrazine + alachlor followed by hoeing and weeding was significantly superior to metribuzin followed by hoeing and weeding in respect of grains/row and grain weight/cob. The highest grain yield was achieved by when weeds were controlled by atrazine + alachlor followed by hoeing and weeding, which was significantly greater than metribuzin followed by hoeing and weeding by exhibiting 5.6% increase (Table 2). While studying the physiological process underlying grain yield loss in maize due to weed competition, Cerrudo *et al.* (2001) concluded that with the early-season presence of weeds there was reduction in photosynthetically active radiation (PAR), which accounted for reduced dry-matter accumulation by maize crop resulting in rapid decline in kernel number and weight that contributed in yield loss. Therefore, alleviation of stress caused by weeds facilitated the crop to utilize the resources like nutrients, space and light in a better way and to produce higher yield by better expression of yield at-

Table 2. Effect of fertility levels, nutrient sources and weed control on yield attributes, yield and economics (pooled data of 2 years)

Treatment	Cobs/plant	Grains/ row	Grain weight/ cob(g)	1000-grain weight (g)	Grain yield (t/ha)	Gross returns (×10³ ₹/ha)	Net returns (×10³ ₹/ha)	Benefit: cost ratio
Fertility levels (N + P_2O_5 kg/ha)								
90 + 40	1.08	33.2	65.4	204.7	3.21	41.99	24.34	1.39
120 + 50	1.18	37.8	77.4	214.4	4.08	53.64	34.89	1.88
150 + 60	1.22	38.7	80.4	219.6	4.28	55.37	35.52	1.83
SEm±	0.02	0.45	1.24	1.43	0.05	0.48	0.48	0.03
CD (P=0.05)	0.05	1.30	3.57	4.11	0.13	1.40	1.40	0.08
Nutrient sources								
100% fertilizers (F)	1.20	38.3	78.8	216.6	4.08	52.52	36.19	2.19
75% F + 25% VC	1.17	36.5	74.2	213.3	3.92	50.65	31.90	1.67
50% F + 50% VC	1.11	34.9	70.2	208.8	3.66	47.83	26.66	1.23
SEm±	0.02	0.45	1.24	1.43	0.05	0.48	0.48	0.03
CD (P=0.05)	0.05	1.30	3.57	4.11	0.13	1.40	1.40	0.08
Weed-control								
Weedy check	1.06	30.1	54.4	197.2	2.93	38.13	21.73	1.37
Metribuzin fb H & W	1.20	38.5	82.0	219.8	4.24	55.09	35.68	1.87
Atrazine + alachlor fb H & W	1.22	41.1	86.8	221.7	4.48	57.79	37.34	1.86
SEm±	0.02	0.31	0.98	1.08	0.04	0.38	0.38	0.02
CD (P=0.05)	0.04	0.88	2.77	3.06	0.10	1.08	108	0.06

F, Fertilizer; VC, vermicompost; fb HW, followed by hoeing and weeding tributes and yield. The present finding is in close agreement with that of Choudhary *et al*. (2013). The interactive effect of fertility levels and weed-control treatments revealed that the 2 weed-control treatments accounted for significant increase in yield over weedy check, but their effects were at par at lower fertility level (90 kg N + 40 kg P_2O_5/ha) under medium (120 kg N + 50 kg P_2O_5/ha) and higher fertility level (150 kg N + 60 kg P_2O_5/ha), atrazine + alachlor followed by hoeing and weeding was significantly superior to metribuzin followed by hoeing and weeding. Under weedy check as well as both the weed control treatments, raising fertility level from 90 kg N + 40 kg P_2O_5/ha to 120 kg N + 50 kg P_2O_5/ha resulted in significantly higher yield. Further increase in rate of nutrient application did not affect the yield significantly (Table 3).

Nutrient uptake

Significant increase in nitrogen and phosphorus uptake by quality protein maize was observed by raising the fertility level up to 150 kg N + 60 kg P_2O_5/ha and the application of entire quantity of NP through fertilizers resulted in the highest NP uptake by the crop. Significant reduction in uptake was recorded by substituting 25 or 50% of fertilizers by vermicompost. Although integrated weed control tended to enhance N and P uptake by crop but atrazine + alachlor followed by hoeing and weeding resulted in significantly higher uptake than metribuzin followed by hoeing and weeding. Though maximum N and P uptake by weeds was brought about by applying 150 kg N + 60 kg P_2O_5/ha, significant increase was observed only by raising fertility level from 90 kg N + 40 kg P_2O_5/ha to 120 kg N + 50 kg P_2O_5/ha. Amongst the nutrient sources, the maximum N and P uptake was registered by 100% application of NP by fertilizers. Significant reduction in uptake was observed when weeds were controlled by atrazine + alachlor followed by hoeing and weeding. It was significantly lesser than metribuzin followed by hoeing and weeding (Table 4). Nutrient uptake by weeds and crop is the direct function of their dry matter and contents. The results substantiate the findings of Mundra *et al.* (2002).

Economics

Increase in fertility level from 90 kg N + 40 kg P_2O_5/ha to 120 kg N + 50 kg P_2O_5/ha increased the net returns significantly (43.3%). Further increase in fertility level showed non-significant increase. Also the highest benefit: cost ratio was obtained with 120 kg N + 50 kg P_2O_5/ha. Amongst the nutrient sources, highest net returns were realized by applying 100% NP through fertilizers. There was a significant descend in net returns by applying 75% NP through fertilizers + 25% through vermicompost. Applying 50% NP through fertilizers + 50% through vermicompost resulted in further significant decrease in net returns. Similar trend was recorded for benefit: cost ratio. In comparison to weedy check, both the weed-control measures tended to enhance net returns but atrazine + alachlor followed by hoeing and weeding was significantly superior to metribuzin followed by hoeing and weeding; however, the 2 treatments were at par in respect of benefit: cost ratio. The interactive effect of fertility lev-

Table 3. Interactive effect of fertility levels and weed control on grain yield and net returns (pooled data of 2 years)

Weed-control	Grain yield (t/ha)		
	Fertility levels (N + P_2O_5 kg/ha)		
	90 + 40	120 + 50	150 + 60
Weedy check	2.46	3.08	3.24
Metribuzin fb H & W	3.52	4.53	4.68
Atrazine + alachlor fb H & W	3.64	4.91	4.90
	SEm±	CD (P=0.05)	
Fertility levels at same weed control	0.08	0.22	
Weed control at same level of fertility	0.06	0.18	
	Net returns (×10^3 ₹/ha)		
Weedy check	16.73	23.58	24.87
Metribuzin fb H & W	27.93	38.99	40.10
Atrazine + alachlor fb H & W	28.35	42.10	41.58
	SEm±	CD (P=0.05)	
Fertility levels at same weed control	0.82	2.32	
Weed control at same level of fertility	0.66	1.87	

fbHW, followed by hoeing and weeding

Table 4. Effect of fertility levels, nutrient sources and weed control on nitrogen and phosphorus uptake by maize crop and weeds (pooled data of 2 years)

Treatment	Uptake (kg/ha)			
	By maize crop		By weeds	
	N	P	N	P
Fertility levels (N + P_2O_5 kg/ha)				
90 + 40	105.4	22.6	35.1	9.1
120 + 50	138.3	29.8	40.8	10.7
150 + 60	146.5	31.7	41.9	10.9
SEm±	1.24	0.25	0.62	0.20
CD (P=0.05)	3.58	0.73	1.79	0.56
Nutrient sources				
100% fertilizers (F)	137.7	28.5	42.1	10.7
75% F + 25% VC	130.7	28.2	39.3	10.2
50% F + 50% VC	121.7	27.5	36.4	9.8
SEm±	1.24	0.25	0.62	0.20
CD (P=0.05)	3.58	0.73	1.79	0.56
Weed-control				
Weedy check	94.2	19.3	76.6	19.0
Metribuzin fb H & W	144.0	31.5	22.0	6.3
Atrazine + alachlor fb H & W	152.1	33.4	19.2	5.5
SEm±	0.91	0.21	0.49	0.16
CD (P=0.05)	2.58	0.59	1.37	0.45

fb HW, Followed by hoeing and weeding; VC, vermicompost

els and weed-control was found significant (Table 3). Though the 2 weed-control treatments gave significantly higher net returns than weedy check, at lower (90 kg N + 40 kg P_2O_5/ha) and higher fertility (150 kg N + 60 kg P_2O_5/ha) level, these treatments were at par whereas at medium fertility level (120 kg N + 50 kg P_2O_5/ha), atrazine + alachlor followed by hoeing and weeding was significantly superior to metribuzin followed by hoeing and weeding. Significant increase in net returns was obtained by raising rate of nutrient application from 90 kg N + 40 kg P_2O_5/ha to 120 kg N + 50 kg P_2O_5/ha under weedy check as well as 2 weed-control treatments in question. Further increase in fertility level was found non-significant.

It was concluded that for obtaining higher yield and economic returns, quality protein maize should be fertilized with 120 kg N + 50 kg P_2O_5/ha through chemical fertilizers and weed control should be done by pre-emergence application of atrazine 0.4 kg + alachlor 2.0 kg/ha followed by weeding and hoeing at 30 days after sowing.

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