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Integrated weed management in maize (*Zea mays)* under different nitrogen levels*

FAYAZ AHMED BAHAR[1], K N SINGH[2] and M A MALIK[3]

S K University of Agricultural Sciences and Technology of Kashmir 191 121

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ABSTRACT

A field experiment was conducted in Kashmir during rainy (*kharif)* season of 2004 and 2005 to study the effect of integrated weed management of maize (*Zea mays* L.) as influenced by different rates of nitrogen levels. The results revealed significant increase in grain yield and growth characters, like plant height, leaf area index and dry matter accumulation with N120 + *Azotobacter* (F4) than N90 (F1) treatment during both the years. Silking was two days earlier in N120 + *Azotobacter* than N90 (F1) treatment. Polyethylene mulch (W5) being at par with straw mulch (W4) resulted in significantly higher grain (5.12 tonnes/ha) yield of maize than weedy check (1.36 tonnes/ha). Uncontrolled weed growth caused 73.41% reduction in grain yield of maize. N120 + *Azotobacter* (F4) recorded significantly higher uptake of N, P and K in maize plant than the lower fertility level of N90 (F1). Significantly higher uptake of N, P and K by maize was observed with all the weed control measures than weedy check (W1) during both the years.

Key words: *Azotobacter,* Maize, Nitrogen, Polyethylene, Straw and weed

In India, maize (*Zea mays* L.) is an important staple food for tribal and rural people and feed for animals. It is a C_4 plant having immense yield potential and is therefore also called as miracle crop. The production of this crop is low in Jammu and Kashmir as compared to the rice and wheat and the cultivation is restricted to the mountainous areas and karewas. The productivity of this crop is also low (1.5 tonnes/ha) in Jammu and Kashmir than the national average (1.9 tonnes/ha) due to inadequate nutrient and weed management. The competition for growth factors in favour of crop can be exploited either with increase in dose of nitrogen due to its more growth rate per unit time or effective control of weeds, particularly before the start of critical crop weed competition is very essential. Unchecked weed growth in this crop may result in grain yield loss to the extent of 100% (Sharma 2005). Keeping in view the above facts the present investigation was undertaken to study the effect of different fertility levels and weed control measures on growth and yield of maize.

MATERIALS AND METHODS

A field experiment was undertaken for two consecutive years of 2004 and 2005 at the experimental farm of the Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir. The experiment was laid in split-plot design and consisted of four treatments, viz. N90 , N120, N90 + *Azotobacter* and N120 + *Azotobacter* in main plot and five treatments, viz. polyethylene mulch, straw mulch @ 15 tonnes/ha, hand weeding at 30 and 60 days after sowing , atrazine @ 1.0 kg/ha and weedy check in sub-plot replicated thrice. The silty clay loam soil was low in available nitrogen (273 kg/ha) and medium in available phosphorus (15.3 kg/ha) and potassium (270 kg/ha) with neutral *p*H· Maize variety 'C 6' was sown in rows at 60 cm apart with plant-to-plant distance of 20 cm using 20 kg seed/ha on the second week of May. A uniform dose of 26 kg P/ha , 33.3 kg K/ha, 8 kg Zn/ha and half dose of nitrogen as per treatment was applied as basal dose to each plot. The remaining half of nitrogen was applied in two equal splits at knee high and tasseling stage as per treatment. Seed dressing by biofertilizer (*Azotobacter* @ 1.0 kg/ha) was done at the time of sowing. Plant height, dry matter accumulation and leaf area index of crop was recorded at harvest and silking, respectively.

*Short note

[1]Assistant Professor-cum-Junior Scientist, (E-mail; baharfayaz @rediffmail.com, baharforu@yahoo.co.in) Department of Agronomy RRS & FOA

[2]Associate Director, Directorate of Extention. (E-mail; singhkndr @ gmail.com)

[3]Assistant Professor-cum-Jr.Scientist, (E-mail; mshtq_mlk @yahoo.com) Department of Biochemistry RRS & FOA

RESULTS AND DISCUSSION

Effect of fertility levels

Taller plants with more dry matter accumulation (DMA) and leaf area index (LAI) of maize was recorded at the higher fertility level of N120 + *Azotobacter* compared to lower fertility level during second year. The increase in dry matter at higher fertility levels of the crop may be attributed to the increase in leaf area index and plant height (Table 1) which resulted in better light interception and accumulation of more photosynthates, thus produced more dry matter. Application of higher quantity of nitrogen has favoured rapid growth and enlargement of tissues resulting in higher leaf area index. Singh and Choudhary (2008) and Bindhani *et al*. (2007) has also confirmed the same findings. Silking was approximately two days earlier in N120 + *Azotobacter* than N90 treatment during both the years. Improved vegetative structures (plant height, leaf area index and dry matter accumulation) favoured the early formation of reproductive structure which helped in the advancement of silking at higher fertility level. These results are in accordance with Bindhani *et al*. (2007).

Radiation interception increased with increase in crop age and recorded the maximum at 90 days after sowing in all the fertility treatments (Table 2). Higher fertility levels (N_{120} + *azotobacter*) recorded the higher values of light interception by mid canopy than the lower fertility level (N_{90}) during both the years. It may be attributed to higher LAI values with higher fertility levels and therefore the more density of stomata and chlorophyll content. These results are in conformity with that of Singh *et al.* (2007). Light interception recorded by crop and weed at the bottom of the canopy exhibited increased light interception (%) at the lower levels of nitrogen at the bottom of canopy of crop and weed during both the years. This was due to more crop weed competition at lower levels of nitrogen as compared to higher fertility levels. Maximum values were recorded with the N_{90} treatment than the N_{120} + *azotobacter* treatment with peak values at the 90 days after sowing of the crop. The increased levels of fertility showed declined trend of light interception towards maturity. The fertility level of N120 recorded 20.8% more grain yield as compared to N90. Integrating of *Azotobacter* with 90 and 120 kg N/ha exhibited an increase in grain yield to the tune of 15.87% and 1.73% over the sole application of N90 and N120, respectively. The increase in grain yield can be ascribed to cumulative effect of improvement in yield-attributing indices, viz cob length, cob diameter and number of cobs/plant (Table 2). Increased grain yield and of maize by the inoculation of biofertilizers has also been reported by Gupta *et al*. (2007). Interaction between fertility levels and weed control measures with respect to grain yield and yield attributing characters was not significant during both the years.

Effect of weed control measures

Among the weed control measures, weedy check recorded significantly lowest plant height, dry matter accumulation and leaf area index (LAI) than rest of the treatments during both the years. Similar findings were reported by Kumar and Walia (2003). Polyethylene mulch recorded highest values of LAI at silking stage with superiority of 5.99 and 3.84, 9.74 and 4.23, 18.73 and 11.5% over the straw mulch, hand weeding at 30 and 60 days after sowing and atrazine @ 1.0 kg/ha treatments, respectively during 2004 and 2005. Significantly higher leaf area index and growth parameters of crop was recorded in polyethylene mulch than hand weeding at 30 and 60 days after sowing treatment (Table 1)

Table 1 Effect of fertility levels and weed control measures on the growth parameters at silking and harvest and grain yield of maize

Treatment		Plant height (cm)		LAI		DMA (tonnes/ ha)		Days to silking		Grain yield (tonnes/ha)		Pooled data
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	
Fertility level												
N90	(F1)	127.68	124.95	3.70	3.86	12.07	11.91	76.13	77.53	3.46	3.34	3.40
N120	(F2)	133.36	131.46	3.98	4.16	13.89	13.65	75.13	76.27	4.38	4.21	4.30
N90 + *Azotobacter*	(F3)	130.74	128.07	3.85	3.96	13.65	13.22	75.40	77.0	4.12	3.98	4.05
N120 + *Azotobacter*	(F4)	135.42	134.98	4.12	4.38	14.09	13.60	74.33	75.53	4.44	4.30	4.37
SEm±		4.002	2.861	0.132	0.161	0.371	0.262	0.325	0.399	0.119	0.109	0.112
C D (*P*=0.05)		NS	8.223	NS	NS	1.285	0.909	1.124	1.382	0.412	0.380	0.388
Weed control measures												
Weedy check	(W1)	93.67	92.12	3.19	3.25	6.16	5.48	78.75	79.33	1.34	1.34	1.36
Atrazine @ 1.0 kg/ha	(W2)	129.78	129.00	3.57	3.94	13.71	13.68	76.33	77.75	4.01	3.80	3.90
Hand weeding at 30 and 60 DAS	(W3)	136.35	133.35	3.97	4.14	15.12	14.99	74.67	76.17	4.83	4.70	4.76
Straw mulch	(W4)	144.27	144.42	4.23	4.40	15.77	15.53	73.67	75.33	5.06	4.90	4.98
Polyethylene mulch	(W5)	153.93	151.00	4.59	4.72	16.37	15.80	72.83	74.33	5.21	5.06	5.14
SEm±		3.004	3.521	0.091	0.111	0.411	0.288	0.441	0.323	0.108	0.101	0.099
C D (*P*=0.05)		9.143	10.801	0.262	0.320	1.185	0.832	1.217	0.929	0.312	0.291	0.286

because of less total weed density, dry matter accumulation and crop weed competition. Significantly less number of days to silking was taken by weed control treatment than the weedy check. Early silking in weed control treatments was due to the rapid development of reproductive structures. Tripathi (2005) and Gopinath and Kundu (2008) also reported the similar findings. Weedy check recorded significantly lowest grain yield and yield-attributing characters than rest of the weed control treatments and was due to more weed density, weed dry matter accumulation, less crop dry weight and higher degree of crop weed competition (Tables 1, 2). Uncontrolled weedy check caused 73.41% reduction in grain yield of maize compared to polyethylene mulch treatment. Polyethylene mulch and straw mulch recorded higher percentage of light interception at the middle canopy than uncontrolled weedy check. It was due to the vigorous crop growth and more LAI in the treated plots than the weedy check treatment. Weedy check recorded higher percentage of light interception than the other weed control treatments during both the years. With depth in plant canopy the radiation load decreased downward due to shading much more so in a weedy check treatment which block light penetration. Increased light interception by maize has also been reported by Singh *et al*. (2007).

Higher fertility levels recorded more nutrient uptake than lower fertility levels and was due to more crop dry weight and less crop weed competition. Crop plants in polyethylene mulch treatment removed 108.45 kg N, 20.28 kg P and 133.35 kg K/ha, whereas it was 102.19 kg N, 19.09 kg P and 121.97 kg K/ha in straw mulch treatment and the corresponding value of N, P and K uptake by crop in weedy check was 33.57 kg N, 5.48 kg P and 38.23 kg K/ha, respectively (Table 2). Similar findings were reported by Sinha *et al*. (2005). This shows that a major share of nitrogen was saved for the benefit of crop by reducing crop weed competition in above treatments. Harvest index did not differ significantly among the different fertility levels, whereas atrazine @ 1.0 kg/ha and weedy check recorded significantly lowest harvest index than hand weeding at 30 and 60 days after sowing, straw mulch and polyethylene mulch, respectively during both the years.

Thus, it can be concluded that higher fertility levels can increase the growth parameters and grain yield of maize and the yield can be improved by the inoculation of biofertlilizers.

Table 2 Effect of fertility levels and weed control measures on weed growth, light interception (%), nutrient uptake, yield-attributing characters and harvest index of maize (pooled data)

Treatment		TWD** (No./m^2)	WDMA (tonnes/ ha)*	Light interception at 90 DAS		Nutrient uptake of maize (kg/ha)			Cob length (cm)	Cob diameter (cm)	Cobs/ plant	Harvest index (%)
				Middle	Bottom	nitrogen	phosphorus	potassium				
Fertility level												
N90	(F1)	9.07 (85)	4.76	58.81	71.88	72.86	13.0	87.85	11.36	2.71	0.92	27.05
N120	(F2)	7.69 (62)	4.12	61.05	68.13	88.42	15.67	105.29	14.43	3.25	1.11	29.15
N90 + *Azotobacter*	(F3)	8.21 (70)	4.53	59.23	69.66	84.52	15.05	100.91	12.95	2.68	0.98	28.3
N120 + *Azotobacter*	(F4)	6.8 (49)	3.63	62.91	65.58	93.40	16.35	115.89	15.10	3.62	1.27	28.9
SEm±		0.234	0.125			2.664	0.511	3.293	0.297	0.132	0.046	0.798
C D (*P*=0.05)		0.812	0.433			9.218	1.769	11.396	1.027	0.455	0.159	NS
Weed control measures												
Weedy check	(W1)	10.2 (107)	5.73	54.34	71.55	33.57	5.48	38.23	10.57	2.39	0.65	21.8
Atrazine @ 1.0 kg/ha	(W2)	8.92 (81)	5.12	59.48	70.15	83.65	13.69	103.76	12.73	2.58	0.85	27.55
Hand weeding at 30 and 60 DAS	(W3)	7.73 (62)	4.65	60.66	69.13	96.13	16.53	115.11	13.16	2.87	1.14	30.9
Straw mulch	(W4)	6.90 (49)	3.16	61.85	67.82	102.19	19.09	121.97	14.61	3.60	1.30	30.95
Polyethylene mulch	(W5)	5.92 (36)	2.09	63.63	65.42	108.45	20.28	133.35	15.34	3.88	1.41	31.00
SEm±		0.224	0.195			2.466	0.616	2.773	0.324	0.105	0.078	0.799
C D (*P*=0.05)		0.517	0.549			7.103	1.775	7.987	0.933	0.304	0.225	2.30

**Original values are given in parentheses and subjected to×+ 0.5 transformation before analysis

TWD, total weed density; WDMA, weed dry matter accumulation

Among the weed control measures polyethylene mulch gave highest grain yield but cannot be applied on commercial scale because of heavy cost investment. Keeping this in view atrazine @ 1.0 kg/ha can be recommended for weed control and higher grain yield in maize and the results can be improved if supplemented by one hand weeding at knee-high stage.

REFERENCES

Bindhani A, Barik K C, Garnayak L M and Mahapatra P K. 2007. Nitrogen management in baby corn (*Zea mays*). *Indian Journal of Agronomy* **52** (2): 135–8.

Gopinath K A and Kundu S. 2008. Effect of dose and time of atrazine application on weeds in maize (*Zea mays*) under mid-hill conditions of Northwestern Himalayas. *Indian Journal of Agricultural Sciences* **78** (3): 254–07.

Gupta R D, Kaistha B P and Kher D. 2007. Ecology of *azotobacter* in soils of Himachal Pradesh and effect of its isolates on maize crop. *Environment and Ecology* **25 S** (4A): 1304–8.

Kumar B and Walia U S. 2003. Effect of nitrogen and plant population levels on competition of maize (*Zea mays* L.) with weeds. *Indian Journal of Weed Science* **35** (1 & 2): 53–6.

Sharma R. 2005. Integrated weed management in *kharif* maize. *Intensive Agriculture* May-June 6–9.

Singh D and Choudhary J. 2008. Effect of plant population and fertilizer levels on yield and economics of pop corn (*Zea mays indurata*). *Indian Journal of Agricultural Sciences* **78** (4): 370–01.

Singh M, Sharma B C, Sharma N, Bali A S and Khushu M K. 2007. Performance of maize cultivars as affected by solar radiation under Jammu conditions. *Environment and Ecology* **25 S** (4A): 1304–08.

Sinha S P, Prasad S M and Singh S J. 2005. Nutrient utilization by winter maize (*Zea mays*) and weeds as influenced by integrated weed management. *Indian Journal of Agronomy* **50** (4): 303–4.

Tripathi A K, Tewari A N and Prasad A. 2005. Integrated weed management in rainy season maize (*Zea mays*) in central Uttar Pradesh. *Indian Journal of Weed Science* **37** (3 & 4): 269–70.