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Short communication

Effect of black gram genotypes and nitrogen levels on yield attributes and yield of maize under maize + black gram intercropping system

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Abstract

A field experiment was conducted during *Kharif* season of 2017 at Agronomy Research Farm, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur to study the effect of black gram genotypes and nitrogen levels on yield attributes and yield of maize under maize + black gram intercropping system. The experiment was laid out in randomized block design comprising of five genotypes of black gram (Him Mash-1, DKU-118, DKU-82, DKU-98 and DKU-99) and two nitrogen levels (50 and 100% recommended dose of nitrogen for maize). Experimental site was silty clay loam in texture, acidic in reaction, low in available nitrogen, and medium in available phosphorus and potassium. Intercropping with different mash varieties significantly influenced yield attributes and yields of maize. The highest number of grains/cob (539), test weight (238 g), grain yield (3501.3 kg/ha) of maize was recorded in maize + Him Mash-1intercropping system. Application of 100 % recommended dose of nitrogen resulted in significantly higher values of yield attributes and yields as compared to 50 % recommended dose of nitrogen.Sole maize crop recorded higher values of yield attributes and yields of maize over intercropped maize. Him mash-1 with 100% recommended dose of nitrogen significantly improved the yield attributes of maize.

Key words: Black gram, maize, yield, yield attributes

Maize *(Zea mays* L.) is the third most important food crop after wheat and rice in India. It is grown on an area of 9.60 million hectares with annual production of 26.26 million metric tons and yield of 2.74 metric tons per hectare (Anonymous 2017). In Himachal Pradesh, it is grown as sole crop as well as an intercrop with pulses. The area under state is 0.294 million hectares with a total production and productivity of 0.737 million tonnes and average yield of 25.1 quintal per hectare, respectively (Anonymous 2016a).Black gram is the third most important pulse crop and is grown on an area of 3.25 million hectares with production of 1.5 million tonnes and yield of 400 kg/ha in the country (Anonymous 2016b). In Himachal Pradesh, it is one of the major pulses, mostly grown as intercrop with maize. It is grown on an area of 0.0079 million hectares with production of 0.0036 million tonnes and yield of 449 kg/ha (Anonymous 2016c).

Maize is a heavy feeder crop responding favorably to fertilization, especially where soils are generally low in native fertility. It is generally observed that maize fails to produce worthwhile grain yields in plots without fertilizer. Nitrogen is one of the essential nutrients for enhancing crop productivity, and for hybrid maize the higher productivity can be obtained only by applying higher dose of nitrogen in addition to phosphorus and potassium. As regard black gram, most of the old varieties of black gram are susceptible to higher dose of nitrogen during their growth period resulting in poor crop yield. On the other hand side, majority of the farmers in the state are marginal, and cannot afford higher dose of nitrogen due to its increasing cost. Considering these facts, the present investigation was carried out to select the suitable genotype of black gram and optimum dose of nitrogen for maize + black gram intercropping system under mid-hill condition of Himachal Pradesh.

The field experiment was conducted during *Kharif* season of 2017 at Agronomy Research Farm, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur situated at 32˚6 N latitude, 76˚3 E longitude and at an altitude of 1290.8 m above mean sea level. The experiment was laid out in a Randomized Block Design comprising of five genotypes of mash (Him mash-1, DKU - 98, DKU-99, DKU - 118 and DKU- 82) and two nitrogen levels (50 and 100 % recommended dose of nitrogen for maize). Each treatment was allocated randomly in each plot using random table and replicated thrice. The soil of the experimental site was silty clay loam with 5.7 pH, 0.56 % OC, 132.63 kg/ha available nitrogen, 14.67 kg/ha available phosphorus and 268 kg/ha available potassium. The meteorological data during the crop season revealed that the weekly maximum and minimum temperature ranged from 25.2 to 29.9 ˚C and 11.6 to 20.8 ˚C, respectively. The mean relative humidity ranged from 50.6 to 95.3 per cent and total of 2340.2 mm rainfall were received during the crop season. The mean bright sunshine hours were 112.9 hours during crop season. Seeds of maize and black gram were treated with bavistin @ 2.5 g/kg seed before sowing for the protection from seed borne diseases. 'Kanchan Hybrid - 101' variety of maize was used as test crop. Maize crop was sown at 60 cm and 20 cm inter and intra row spacing, respectively.Black gram was sown in between two rows of maize (1:1) as intercrop. Other package of practices recommended for the region were also followed. Data recorded on yield attributes and yields were subjected to analysis of variance with mean comparison of 5 percent level of significance.

Number of cobs per plant of maize intercropped with different black gram genotypes remained unaffected while it was significantly affected by different nitrogen levels. The highest number of cobs per plant was recorded at 100 per cent recommended dose of nitrogen. The results confirm the findings of Bakht *et al*. (2006). Statistically equal number of cobs per plant was noted in sole as well as intercropped maize (Table 1). Significant interaction effect of black gram genotypes and nitrogen levels on cobs per plant was recorded. Significantly higher number of cobs/plant was recorded in Him mash-1 × N_{100} whereas lower was in DKU-118 × N_{50} (Table 2).

Number of grains per cob was also significantly affected by black gram genotypes. Maize intercropped with Him Mash-1 resulted in higher number of grains per cob. Significantly higher number of grains per cob was recorded with 100 per cent recommended dose of nitrogen than 50 per cent recommended dose of nitrogen. The increase in number of grains per cob at higher nitrogen levels might be due to more dry matter accumulation leading to extension of grain filling period along with effective translocation of photosynthates to the sink. The results confirm the findings of Bakht *et al*. (2006). Sole maize recorded significantly higher number of grains per cob than intercropped maize. Similar results were observed by Patra et al. (1990). Among interaction treatments, Him Mash-1 × N_{100} significantly recorded higher number of grains per cob while DKU-118 × N_{50} recorded the lowest number of grains per cob.

Black gram genotypes also significantly affected the test weight. Significantly higher value of test weight was recorded with Him mash-1. 100 per cent recommended dose of nitrogen recorded higher test weight than 50 per cent recommended dose of nitrogen. Similar results were recordedby Suryavanshi *et al*. (2008) and Savitha *et al*. (2011). Between sole and intercropped maize, significantly higher test weight was recorded with sole maize than intercropped maize. Interaction effect of black gram genotypes and nitrogen levels significantly affected test weight. Maize + Him Mash 1 intercropping resulted in the highest test weight (244.3g) at 100 per cent recommended dose of nitrogen (Table 2).

Grain yield was significantly affected by different genotypes of black gram. The highest grain yield (3501.3 kg/ha) was recorded with Him mash-1. Grain yield was also significantly affected by different nitrogen levels. The highest grain yield (3717.3 kg/ha) was recorded at 100 per cent recommended dose of nitrogen than 50 per cent recommended dose of nitrogen (2876.0 kg/ha). Grain yield was 29.25 per cent higher at 100 per cent than 50 percent recommended dose of nitrogen. Maize is a nutrient exhaustive crop and performs better with adequate nutrition. Higher dose of nitrogen in addition of other nutrients resulted in improved growth and yield attributes of maize resulting in higher grain yield. Raskar *et al*. (2012) also observed similar findings. Sole maize recorded significantly higher grain yield (6.6%) than intercropped maize. Similar results were

Table 1. Effect of black gram genotypes and nitrogen levels on yield attributes, yields and harvest index of maize under maize + black gram intercropping system

Treatment	Yield attributes			Yields (kg/ha)		Harvest
	Number of cobs / plant	Number of grains/cob	Test weight (g)	Grain	Stover	Index (%)
Black gram genotypes						
Him Mash -1	1.4	539.4	238.0	3501.3	6433.7	32.5
DKU-118	1.4	520.8	228.8	3157.4	5848.5	32.4
DKU-82	1.3	525.4	232.3	3273.8	6085.2	32.2
DKU-98	1.4	528.9	230.4	3208.5	6003.8	32.1
DKU-99	1.4	536.2	234.6	3341.5	6253.8	32.3
SEm±	0.08	0.61	0.56	35.65	81.0	0.41
CD (P =0.05)	NS	1.79	1.64	105.16	238.9	NS
Nitrogen levels (% RDN)						
50	1.3	507.0	226.7	2876.0	5938.6	30.3
100	1.5	553.3	239.0	3717.3	6311.4	34.2
SEm±	0.05	0.38	0.35	22.55	51.23	0.26
CD (P =0.05)	0.15	1.13	1.04	66.51	151.14	0.76
Sole maize vs Intercrop maize						
Sole maize	1.4	522.75	240.7	3515.16	6397.7	32.81
Intercrop maize	1.38	530.14	232.8	3296.68	6125.0	32.28
SEm±	0.12	0.90	0.82	52.65	119.6	0.60
CD (P =0.05)	NS	2.59	2.38	152.39	346.3	NS

RDN- Recommended dose of nitrogen

Table 2. Interaction effect of black gram genotypes and nitrogen levelson number of cobs per plant, grains per cob and test weight of maize under maize + black gram intercropping system

Black gram genotypes	Nitrogen levels (% RDN)					
	N_{50}	N_{100}	N_{50}	N_{100}	N_{50}	N_{100}
	No. of cobs/plant		No. of grains/cob		Test weight (g)	
Him Mash-1	1.33	1.53	519.1	559.7	231.8	244.3
DKU-118	1.33	1.40	494.1	547.4	223.7	233.8
DKU-82	1.20	1.47	497.4	553.4	225.9	238.7
DKU-98	1.33	1.47	507.8	550.0	224.8	236.0
DKU-99	1.27	1.47	516.4	556.1	227.2	242.1
SEm±	0.12		0.86		0.79	
CD (P=0.05)	0.34		2.53		2.32	

RDN- Recommended dose of nitrogen

also observed by Mandal *et al*. (2014). Interaction among black gram genotypes and nitrogen levels did not affect the grain yield of maize.

Stover yield was also significantly affected by black gram genotypes. Significantly higher stover yield of maize was recorded with Him mash-1 which was at par with DKU-82. Stover yield was also significantly influenced by different nitrogen levels. Higher stover yield was recorded with 100 per cent recommended dose of nitrogen than 50 per cent recommended dose of nitrogen (Table 1). Increase in dry matter accumulation due to more uptake of nitrogen might have contributed to increase in stover yield. Similar results were observed by (Bakht *et al*. 2006; Suryavanshi et al. 2008; Savitha *et al*. 2011; and Khatun *et al*. 2012). Sole maize recorded significantly higher stover yield than intercropped maize. Similar results were also observed by Mandal *et al*. (2014). Interaction effect of black gram genotypes and nitrogen levels was found to be non-significant.

Black gram genotypes did not affect the harvest index. However, Him mash-1 recorded numerically higher harvest index. The highest value of harvest index was recorded at 100 per cent recommended dose of nitrogen. Similar results were observed by Khatun *et al*. (2012). Sole and intercropped maize showed similar value of harvest index. Interaction effect of black gram genotypes and nitrogen levels in respect of harvest index was found to be non-significant.

The present study inferred that maize intercropped with Him mash-1 with 100 percent recommended dose of nitrogen is the best treatment for increasing productivity of maize + blackgram intercropping system under mid-hill condition of Himachal Pradesh.

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