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ASSESSMENT OF NITROGEN AND PHOSPHOROUS APPLICATIONS FOR YIELD POTENTIAL OF GUAR STRAINS UNDER IRRIGATED CONDITIONS

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ABSTRACT

The productive efficiency of two guar varieties BR-2017 and BR-99 was studied with variable nitrogen and phosphorous levels including 0-0, 0-60, 15-60, 30-0, 30-30, 30-60, 30-90 and 45-60 NP kg ha^{-1}during two sowing seasons 2015 and 2016 at Agriculture Research Station, Bahawalpur. The results showed that BR-2017 performed better than the BR-99. Variable levels of nitrogen and phosphorous also enhanced the yield of guar. The results indicated that maximum average grain yield of guar 2544 kg ha^{-1} was recorded in BR-2017 with NP dosage of 30:60 kg ha^{-1} nitrogen and phosphorous that was non-significantly different (2458 kg ha^{-1}) from NP level of 30:90 kg ha^{-1} recorded from same variety. Results indicated that 'BR-2017' was more receptive to fertilizer application than the BR-99.

Key Words: Cluster Bean, Nitrogen, Phosphorous**,** Varieties, Split Plot Design, ANOVA, LSD.

INTRIDUCTION

Cluster bean or Guar [*Cyamopsis tetragonoloba* (L.) Taub.] is a self-pollinated legume crop. Guar is a potential summer crop having the ability to fix nitrogen from atmosphere and resist drought conditions because of it have tap root system that goes down and results in more efficacy of water intake (Farencois *et al.*, 1990). Cluster bean is the main crop in drought prone areas of United States, South Africa, India and Pakistan (Ashraf *et al.*, 2005). It performs well under warm climate and with supplementation of irrigation (Alexander *et al.*, 1988) and fertilization (Omer *et al*., 1993). Guar has the ability to fix nitrogen in the atmospheric due to nodules (Elsheikh and Ibrahim, 1999; Wetselaar, 1967) and can tolerate saline soils (Farencois *et al*., 1990; Ashraf *et al*., 2005).

The major portions of arid areas of the Indo-Pak are occupied by guar due to its legume capability. Guar seed have guar gum (galactomannans, 25-35%), 4% edible oil (Mehta and Ramakrishanan, 1957) and 27 to 37% protein (Whistler and Hymowitz, 1979) that are used for industrial purposes like stabilizer, food industry, cosmetics, paint, textile and detergent (Farencois *et al*., 1990; Jukanti *et al.*, 2015). Guar gum is also used in several industries like mining, sauces, dairy products, meat blinder etc. (Morris, 2004; Kays *et al*., 2006) as well as beverages, photography, petroleum and paper (Whistle and Hymowitz 1979; Undersander *et al.*, 1991; Pathak *et al*., 2010). Guar can be used for agricultural purposes like fodder for animals, vegetable green manuring, (Douglas, 2005). Due to its reduced transpiration and deeper root system it can reduce the shortage of forage in the months of deficit of forage (Paleg and Aspinal, 1981).

The cultivation of legumes is limited to neglected lands without application of any artificial fertilizer. The atmospheric nitrogen is fixed by leguminous crops through symbiotic relationship with bacteria to meet their nitrogen requirements (Herridge *et al.*, 1993). The phosphorus and potassium requirement of leguminous crops is more than cereals because NP is required for BNF bacteria and legume crop itself for its better growth. The available potassium (NFDC, 1994) and phosphorus are deficient in most Pakistani soil (Fatima *et al.*, 2006). The application of phosphorus in soil not only enhance the weight per plant (Patel and Kotecha, 2006; Tariq *et al*., 2007) but also increases its percentage of protein (Joshi and Mali, 2004). The reduced activity of nitrogen fixing bacteria reduced the nitrogen available in the root zone due the deficiency of phosphorus in leguminous crops (Giller and Cadisch, 1995; Rahman *et al*., 2008). The weight of individual nodule increased upto four times due to the application of phosphorous and potassium. (Lynda *et al.*, 1984).

The inoculation of seed with Rhizobium and NP application significantly affected the grain yield of guar except germination, primary branches, No. of Pods per plant and harvest index (Khan *et al*., 1992) The application of nitrogen @ 100 kg ha^{-1} significantly increase the seed yield and dry weight per plant and inoculation of seed did not affect the seed yield (McKenzie *et al.,* 1992). The application of nitrogen @ 25 kg ha^{-1} enhanced the grain yield of chickpea (1.3 ton ha^{-1}) (Kasole *et al*., 1995). The application of nitrogen @ 25 kg ha^{-1} enhanced the protein contents and seed yield however seed yield and protein contents was stable up to 50 kg N per ha (Kurhade *et al*., 1994).

Therefore, nitrogen and phosphorus are essential for better growth of crop and nutritional status in dry matter. The present study was conducted to assess the growth and yield of guar cultivars BR-99 and BR-2017 to variable NP doses under irrigated conditions of Bahawalpur.

MATERIALS AND METHODS

In this study, two varieties of Guar viz.; BR-99 (V1) and BR-2017 (V2) were grown with eight different levels of NP fertilizer at the Agricultural Research Station, Bahawalpur during 2015 and 2016. The fertilizer levels T1 (0-0), T2 (0-60), T3 (15-60), T4 (30-0), T5 (30-30), T6 (30-60), T7 (30-90) and T8 (45-60) kg NP ha^{-1}were applied at the time of land preparation before sowing. The trial was laid out in a split plot design with three replications. Varieties were kept in main plot and fertilizer levels in sub-plots. A plot size of 1.8 m x 6 m keeping six (4) rows 45 cm apart was maintained. The whole quantity of nitrogen and phosphorus was applied in the form of urea and single super phosphate, respectively. All other cultural practices were kept uniform in all the plots. At physiological maturity of the crop, yield data were recorded. The samples harvested for grain yield were sun dried and threshed. The data were subjected to ANOVA and the treatments means were compared by LSD at 5% level of probability (Steel and Terrie, 1984).

RESULTS AND DISCUSSION

The highest average seed yield of guar 2544 kg ha^{-1} was obtained by BR-2017 with the application of 30-60 kg ha^{-1} NP that was statistically at par with 30-90 kg ha^{-1} NP fertilizer (2458 kg ha^{-1}). The results indicated that ‘BR-2017’ variety performed well to the application of NP fertilizer as compared to BR-99. The minimum average seed yield of guar (842 kg ha^{-1}) was recorded in BR-99 variety in control where no fertilizer was applied (Table-1).

Treatments, varieties and treatments × varieties interactions were highly-significant and having a difference between all varieties which showed different yield potential at different level of fertilizers. There were no significant differences between blocks (table 2 & 5).

Fertilizer level T6 indicated maximum yield potential. The data showed that average grain yield of guar at variable NP levels was between 969 kg ha^{-1} to 2145 kg ha^{-1}. The average grain yield was non-significant with the appliance of 30-90 and 45-60 kg NP ha^{-1}. The optimal level for maximum production of grain yield of guar is 30-60 kg NP ha^{-1} because the inadequate application of fertilizer results vegetative growth resulting in loss of grain yield (Table 3 & 6).

BR-2017 showed maximum yield potential than BR-99. Average grain yield data indicated that both the guar varieties responded well to variable levels of NP and varieties differ significantly among treatment means. The results on average grain yield of guar varieties indicated that both the varieties differ significantly to various levels of NP. The yield parameters like no of pods $plant^{-1}$ and no of pods $cluster^{-1}$ of BR-2017 and BR-99 also supported the increase in yield of guar. (Table 4 & 7).

Data presented in table-1 showed that grain yield of both cultivars BR-2017 and BR-99 was significantly increases with variable levels of nitrogen and phosphorous. The above discussed consequences are comparable with Yaqoob *et al*. (2005) and Bashir *et al*. (2006) i.e. chickpea and lentil varieties differ among yield that are developed through selection. Thus, the ‘BR-2017’ is recommended for cultivation for the purpose of increase in guar yield compared to other varieties of Guar.

Table 1. Average yield data of guar varieties kg ha^{-1} at different levels of NP 2015 and 2016.

Year		**2015**		**2016**	
Variety		**BR-99**	**BR-2017**	**BR-99**	**BR-2017**
T1	0-0	859.5	1115.5	842.0	1089.0
T2	0-60	1167.5	1181.0	1512.0	1644.0
T3	15-60	1221.0	1507.5	1318.0	2182.5
T4	30-0	1061.5	1366.5	982.0	1370.5
T5	30-30	1484.0	1970.0	1646.0	2331.5
T6	30-60	1694.0	2366.0	1797.0	2544.0
T7	30-90	1690.5	2212.0	1689.0	2457.5
T8	45-60	1482.5	2095.0	1573.0	2058.5

Table 2. ANOVA 0f yield data of two guar varieties at various NP levels during 2015.

ANOVA	**D.F**	**SS**	**MS**	**F calculated**	**F tabulated**
Block	2	78327.1	39163.5	1.85	0.3 NS
Varieties	1	2252466.7	2252466.7	106.56	0.009 **
Error 1	2	42274.5	21137.2		
Treatment	7	7749240.2	1107034.3	36.48	0.0 ***
V× T	7	326824.9	46689.2	7.5	0.2 **
Error 2	28	849728.3	30347.4		
Total	47	11298861.9			

Table 3. Yield ranking of guar by the effect of N and P fertilizers 2015.

Rank Mean	**Level NP**	**Mean(kg ha^{-1})**	**Ranking**
T6	30-60	2045.6	A
T7	30-90	1957.1	AB
T8	45-60	1848.3	AB
T5	30-30	1692.3	B
T3	15-60	1355.6	C
T4	30-0	1204.6	CD
T2	0-60	1013.1	DE
T1	0-0	968.6	E

Table 4. Grain yield of guar varieties as influenced by fertilizer application 2015

Variety		**Mean(kg ha^{-1})**	**Ranking**
BR-2017	V2	1727.33	A
BR-99	V1	1294.083	B

Table 5. ANOVA0f yield data of two guar varieties at various NP levels during2016

ANOVA	**D.F**	**SS**	**MS**	**F calculated**	**F tabulated**
Block	2	195102.1	97551.062	0.97	.50NS
Variety	1	3441123	3441123	34.28	.02 *
Errore1	2	200765.3	100382.6		
Treatment	7	7236619.2	1033802.8	66.70	.0 ***
V× T	7	1081801.6	154543.1	9.97	.0 ***
Errore2	28	433429.8	15479.6		
Total	47	12588841.2			

Table 6. Yield ranking of guar by the effect of N and P fertilizers 2016.

Rank Mean	**Level NP**	**Mean (kg ha^{-1})**	**Ranking**
T6	30-60	2144.5	A
T7	30-90	2122.3	B
T5	30-30	1912.6	B
T8	45-60	1900.8	B
T3	15-60	1734.6	C
T2	0-60	1499.8	D
T4	30-0	1199.1	E
T1	0-0	1027	F

Table 7. Grain yield of guar varieties as influenced by fertilizer application 2016.

Variety		**Mean (kg ha^{-1})**	**Ranking**
BR-2017	V2	1960.3	A
BR-99	V1	1424.8	B

Conclusion

Both the varieties differed significantly for grain yield potential by utilization of different levels of fertilizer. An improved variety “BR-2017” responded more efficiently to fertilizer than BR-99 variety. Thus, it can be concluded that the farmers can adopt newly approved variety of guar with appropriate doses of fertilizer (30-60 kg NP ha^{-1}) application to increase their yield.

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