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Effect of land configuration and nutrient management regimes on performance and productivity of black gram (*Vigna mungo* l.)

DEEPAK PANDEY, S.S. TOMAR*, ADESH SINGH, AVNISH KUMAR PANDEY[1] AND MANOJ KUMAR[2]

Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India – 250110

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ABSTRACT

A field experiment was conducted during kharif season of 2015 on sandy loam soil at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, to evaluate the effect of land configuratuion and nutrient management regimes on growth, yield and economics of black gram (Vigna mungo L.). The treatments comprised of three land configurations (Flat bed, Narrow bed and Broad bed) as main plot and five nutrient management options [control, 25:60:30 kg (N, P & K) at basal dose, 25:60:30 kg (N, P & K) + Rhizobium + PSB at basal dose, 25:60:30 kg (N, P & K) + 25 kg S at basal dose + 0.5% foliar spray of Fe at 45 DAS and 25:60:30 kg (N, P & K) + Rhizobium + PSB + 25 kg S at basal dose + 0.5% foliar spray of Fe at 45 DAS] as sub plot were tested in a split plot design with 3 replications. The results revealed that broad bed planting recorded significantly higher growth attributes viz.,plant population (283860), plant height (70.8 cm), number of branches per plant (7.96), dry matter accumulation (21.9 g), LAI at maturity (1.31), days taken to 50% maturity (57.51). Yield attributing characters viz pods/plant (18.6), pod length (7.2 cm), grains/pod (7.4), test weight (42.6 g) and yield (9.4 q ha^{-1}) and straw yield (21.7q ha^{-1}) and B:C ratio (1.82) was significantly higher with broadbed planting as compared to flat bed method. Among nutrient management options, 100% RDF + Rhizobium + PSB + 25 kg S at basal dose + 0.5% foliar spray of Fe at 45 DAS produced highest values of all the growth and field attributing parameters than rest of the treatments. The grain and straw yield increased by 74.2 and 33.2% with 100% RDF + Rhizobium + PBS + 25kg S ha^{-1} as basal dose + 0.5% folear spray of Fe at 45 DAS over control, respectively.

Key words: Economics, Land configurations, LAI, Nutrient management regimes, *Rhizobium* and PSB

INTRODUCTION

Pulse crops have played a very important role in human diet of our country, as a source of protein (24.04%), carbohydrate (60%), fat (1.5%), amino acids, phosphoric acids, vitamins and minerals consumed in the form of “dal”. Black gram (*Vigna mungo* L.) is a major pulse crop of the kharif. Being a leguminous crop Urdbean improves soil fertility through symbiotic nitrogen fixation. Inspite of being widely adopted crop, its per hectare yield is very low. This might be due to poor fertility status of soil, therefore fertility management is imperative to ensure better crop production in exhausted soil of western Uttar Pradesh by growing rice- wheat cropping system year after year. The cultivation of *kharif* urdbean in western Uttar Pradesh faces many problems like water logging and poor aeration which adversely affects the growth and yield in flat bed conditions. Faulty land management practices and imbalanced use of nutrients are the main reasons for low productivity and soil fertility (Bhadoria 2018). In north western India, urdbean is often sown under marginal and sub-marginal lands. Therefore, the balanced and efficient nutrient management is needed, which could be achieved through combination of NPK and sulphur with micronutrient like iron and bio-fertilizer (*Rhizobium* and PSB). Black gram has been universally accepted as responsive crop to the application of macronutrients. It requires less amount of nitrogen as it is synthesized by nodulated bacteria. Phosphorus is the key element for legumes and it is required in large amount by these crops. Potassium influences root growth, number and weight of root nodules and quality of grains (Pramanik and Singh, 2006). Sulphur, a key element for higher pulse production, is required in the formation of proteins, vitamins and enzymes. Besides, it is involved in biological nitrogen fixation and iron as a micronutrient plays an important role for plant growth and development. The soils of western Uttar Pradesh are sandy loam in

[1] *Division of Agronomy, IARI Regional Station, Samastipur, Pusa (Bihar) India– 848125*
[2] *Department of Agronomy, NDUA&T, Kumarganj, Faizabad (U.P.) India– 224229*
****Corresponding author Email:****sandeeptomar1972@gmail.com*

texture, slightly alkaline in reaction and low in organic carbon. Crops grown in such soil conditions would suffer multi nutrients deficiencies including sulphur and iron (Sahu *et al.* 2008). Foliar spray of $FeSO_4$ is commonly used as a mean to control lime induced chlorosis on field grown on calcareous soil but spraying with iron salts alone has usually been found to be less effective because of precipitation of iron from the spray solution and poor translocation of applied iron within the plant.Micro-organism converted the insoluble phosphates in to soluble phosphate by acidification, chelation, ion exchange reaction and production of low molecular weight organic acids (Barroso *et al.*, 2006). The use of these microbes helps not only to affect the high cost of phosphatic fertilizers but also to mobilize insoluble phosphate in fertilizer and soils. The information on nutrient management in urdbean under different land configuration is meagre. Therefore a study was planned to find out the appropriate land configuration and nutrient management module for *kharif* urdbean in western Uttar Pradesh.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* season of 2015 at crop research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (UP) located at a latitude of $29^0$4' North and longitude of $77^0$41' East with an elevation of 237 meters above mean sea level. The mean temperature of 42 to 46 ^{0}C was recorded in the month of June and minimum touches as low as 15.6^{0}C in October. The mean annual rainfall during crop period was 650-805 mm (80% of which is received during July to September) and average relative humility varied from 67 to 83% throughout the year. The experimental field was well drained, sandy loam in texture (64.3 % sand, 18.2 % silt and 17.5 % clay) and slightly alkaline in reaction (pH 7.9). It was medium in organic carbon, available nitrogen and phosphorus but high in available potassium (0.56 %, 175 kg ha^{-1}, 13.5 kg ha^{-1} and 240.0 kg ha^{-1}), respectively with an bulk density of 1.43 Mg/m^3. All the physio-chemical properties were analyzed as per the standard procedures given by Jackson (1973). The experiment was laid out in split plot design with three replications. The treatments were having three land configurations (Flat bed, narrow bed and broad bed) and five nutrient management options (control, 100% RDF, 100% RDF + *Rhizobium* + PSB, 100% RDF + S + Fe (0.5%) and 100% RDF+ S + Fe (0.5%) + *Rhizobium* + PSB). The recommended doses of fertilizers (RDF) for urdbean were 25:60:30:25 kg of N, P_2O_5, K_2O and S ha^{-1}, respectively and Fe (0.5%) foliar spray at 45 DAS. The entire quantity of NPK and S fertilizer was applied as basal dose at the time of sowing. Seed inoculation with biofertilizer namely phosphate solubilising bacteria and *Rhizobium* @ 20 g kg^{-1} seed each was done as per treatments. Urdbean cv. PU 40 was sown in rows at 33.5 cm apart using a seed rate of 15 kg ha^{-1} during *kharif,* 2015. The crop was grown as per recommended package of practices and harvested on 20th October 2015. Observations on various growth parameters *viz.*, plant height, braches/plant and dry matter accumulation/plant and yield attributes were recorded at harvesting stage. The yield was estimated by the produce obtained from net plot area at 14 % moisture. The B: C ratio was worked out at the prevailing market prices of the inputs and outputs at the time of harvest. The soil samples were collected from 0 to 20 cm depth before sowing and after harvest of crop. The data collected for different parameters were statistically analysed using the *F*-test as per the procedure given by Gomez and Gomez (1984) for split plot design. The results are presented at 5% level of significance (P= 0.05) for making comparison between treatments.

RESULT AND DISCUSSION

Growth parameters

Growth parameters such as plant height, branches/plant, dry matter accumulation, leaf area index and days taken to 50% maturity were significantly affected with land configuration and nutrient management practices (Table 1). Significantly higher plant height was recorded under broad bed (70.87 cm) as compared to narrow bed (67.5 cm) and least were recorded in flat bed (64.7 cm). Similar trends were found in other growth parameters like branches, dry matter accumulation, leaf area index and days taken to 50 % maturity. It might be due to better availability of nutrients and moisture to the crop and less competition for natural resources as evident from the beneficial effects on the crop growth. These results were in the conformity with the finding of Tomar *et al.* (2015). Among nutrient management practices, 100% RDF + S + Fe + *Rhizobium* + PSB produced the tallest plant (71.3 cm), more branches (8.15), dry matter accumulation (23.02 g), leaf area index (1.62) and days taken to 50 % maturity (59.13) which were significantly higher over rest of the treatments. While branches were at par with 100% RDF + *Rhizobium* + PSB (7.36). Minimum dry matter accumulation (17.86) was found under control plot which was significantly lower than rest of the treatment but treatments 100% + S + Fe was at par with 100% RDF + *Rhizobium* + PSB and 100% RDF. The overall improvement in the growth of black gram with the addition of fertilizers could be ascribed to their pivotal role in several physiological and biochemical process, viz., root development, photosynthesis, energy transfer reaction and symbiotic biological N fixation process. These results were in the conformity with the findings of Tomar *et al.*(2015). Besides that, PSB releases plant growth promoting substances by phosphobacteria.

Table 1: Effect of land configuration and nutrient management regimes on growth parameters of black gram

Treatment	Plant population ('10^4/ha)	Plant height (cm) at maturity	No. of branches/ plant	Dry matter accumulation (g)	Leaf area index	Days taken to 50 % maturity
Land configuration						
Flat bed	27.91	64.70	6.70	18.89	1.07	55.40
Narrow bed	28.54	67.57	8.17	20.28	1.22	56.30
Broad bed	28.38	70.87	7.96	21.90	1.31	57.51
S.Em.±	0.26	0.49	0.11	0.27	0.01	0.37
CD (P= 0.05)	1.03	1.94	0.43	1.08	0.07	1.46
Nutrient management						
Control	27.47	63.31	7.15	17.86	0.76	53.67
100% RDF	27.90	66.67	7.36	20.03	1.07	56.06
100% RDF + *Rhizobium* + PSB	28.27	68.31	7.54	20.32	1.17	56.32
100% RDF + S + Fe (0.5%)	28.67	68.98	7.85	20.56	1.36	56.82
100% RDF + S + Fe (0.5%) +*Rhizobium* + PSB	29.07	71.30	8.15	23.02	1.62	59.13
S.Em.±	0.45	0.54	0.16	0.43	0.03	0.10
CD (P= 0.05)	1.34	1.58	0.48	1.28	0.09	0.30

Yield and yield attributes

Yield per hectare varied significantly due to different land configuration and nutrient management options (Table 2). Highest grain yields of 9.39 q ha^{-1} was recorded under broad bed planting which was significantly superior over flat bed planting. The highest grain yield under broad bed planting was mainly due to higher yield attributes (pods per plant, pod length, grains per pod and test weight). Similar trend was also found in straw yield in which broad bed planting (21.76) out yielded over flat bed method (19.17). The highest grain and straw yield in this treatment was mainly due to the fact that under favourable soil conditions, the plant accumulates and translocates of photosynthates from source to the sink more efficiently which inturn increased all the growth and yield attributes too. Similar results were also reported by Jadhav *et al.* (2008).

Application of 100% RDF + S + Fe + Rhizobium + PSB recorded the highest grain (10.35 q ha^{-1}) and straw (22.53 q ha^{-1}) yields. However, a significant improvement was observed with 100% RDF + S + Fe and recorded 9.46 q ha^{-1} grain yield and 21.4 q/ha straw yield. Application of 100% RDF + Rhizobium + PSB significantly recorded 8.81 q ha^{-1} grain yield and 20.83 q ha^{-1} straw yield than control plot. The improvement in yield might have resulted from favourable influence of fertilizers on the growth attributes and yield components, efficient and greater partitioning of metabolites and adequate translocation of photosynthates and nutrients to developing reproductive structures. These results confirm the finding of Tomar *et al.* (2015) and Singh (2017).

Table 2: Effect of land configuration and nutrient management regimes on yield attribute and yield character of black gram

Treatments	Pods/ plant	Pod length (cm)	Grains/ pod	1000 grain weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	B:C Ratio
Land configuration							
Flat bed	17.01	5.40	5.57	40.63	7.77	19.17	1.34
Narrow bed	17.79	6.58	6.86	41.42	8.55	20.24	1.56
Broad bed	18.68	7.20	7.47	42.68	9.39	21.76	1.82
S.Em.±	0.13	0.08	0.09	0.24	0.14	0.35	-
CD (P= 0.05)	0.51	0.34	0.37	0.97	0.55	1.38	-
Nutrient management							
Control	15.06	4.36	4.46	35.33	5.94	16.91	1.16
100% RDF	17.45	5.56	5.68	40.97	8.28	20.28	1.46
100% RDF + *Rhizobium* + PSB	17.81	6.45	6.72	41.60	8.81	20.83	1.61
100% RDF + S + Fe (0.5%)	18.22	7.33	7.60	43.67	9.46	21.40	1.65
100% RDF + S + Fe (0.5%) +*Rhizobium* + PSB	20.58	8.24	8.71	46.30	10.35	22.53	1.88
S.Em.±	0.09	0.14	0.15	0.57	0.06	0.17	-
CD (P= 0.05)	0.27	0.43	0.44	1.67	0.18	0.50	-

Yield attributes like pods/plant, pods length, grains/pod and test weight under broad bed method were significantly higher as compared to narrow bed and flat bed. Superiority of broad bed method might be due to better growth parameters and tanslocation of photosynthetic in efficient manner. Our results were also with the conformity of findings of Jadhav *et al.* (2008) and Singh and Singh (2017). All the yield attributes were also affected significantly by different nutrient management practices. Higher number of pods/plant, seeds/pod, highest pod length and test weight were recorded with 100% RDF + S + Fe + Rhizobium + PSB which was significantly higher over rest of the treatments. The higher values of yield attributes might be associated with increased availability of nutrients due to balanced nutrition and PSB which in turn played an important role in rapid cell division and elongation in meristimatic tissues, root development and proliferation and enhancing flowering, pod setting and seed formation. Singh and Singh (2014) have also made similar observations. The highest B: C ratio was recorded under broad bed (1.82) than narrow bed (1.56) and flat bed (1.34). Beside 100% RDF + S + Fe + Rhizobium + PSB also recorded higher B:C ratio (1.88) as compared with other treatments like 100% RDF + S + Fe (1.65), 100% RDF + Rhizobium + PSB (1.61) and 100% RDF (1.46). The minimum value (1.16) of B:C ratio was recorded under control, which may be attributed to poor yield of the crop in control treatment.

Based on the study, it may be concluded that broad bed sowing proved its superiority over narrow bed and flat bed by producing higher grain yield beside, empowering grown, yield attributes. Application of 100% RDF + S + Fe + Rhizobium + PSB was found to be more effective for improving growth parameters than all over rest of the treatments. Thus, urdbean can be successfully grown under semi–arid condition of Uttar Pradesh on broad bed along with 100% RDF + S + Fe + Rhizobium + PSB with maximum productivity and profitability.

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