International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 325-329

Received: 25-09-2019
Accepted: 27-10-2019

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To study the effect of fertilizer doses, organic manure and biofertilizers on yield attributes and yield of urdbean (*Vigna mungo* L.)

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Abstract
A field experiment entitled "Effect of fertilizer doses, organic manure and biofertilizers on yield and economics of urdbean (*Vigna mungo* L.)" was conducted during kharif season of 2017 at the Research cum Instructional Farm, under all India Coordinated Research Project on MULLaRP, Department of Agronomy, College of Agriculture, I.G.K.V. Raipur, Chhattisgarh. The urdbean var. Indira urd pratham was sown on 18th July, 2017 using experimental techniques of factorial randomized block design with three replications and sixteen treatments. The treatment consisted of four fertilizer doses, two organic manure and two biofertilizer treatments. Application of 125% RDF followed by 100 % RDF and 5 t FYM ha^{-1} recorded higheston yield attributes and yield of urdbean.

Keywords: Urdbean, RDF, FYM, biofertilizer

Introduction
In India, pulses have been cultivated since time immemorial under rainfed situations which is characterized by poor soil fertility and moisture stress. These crops are energy rich but cultivated largely under energy starving situations. Unlike in cereals, varietal breakthrough in pulses has not been taken place. Pulses occupies 29.46 m ha area and contributes 22.95 mt production with an average productivity of 779 kg ha^{-1} (Anonymous, 2016-17) [1]. During the last four decades, the total area under pulses remained virtually stagnant (22 to 24 m ha) with almost stable production (12 to 14 mt), even though the population has been increased. As a result, per capita availability of pulses has been declined from 64 g day^{-1} in 1951-56 to less than 40 g day^{-1} as against WHO's recommendation of 80 g day^{-1} (Asthana and Chaturvedi, 1999) [2]. This situation led to the severe shortage of pulses in India, which has aggravated the problem of malnutrition in large section of vegetarian population of our country. Total pulse area in Chhattisgarh is 884.5 thousand hectares which contributes 527.1 thousand tonnes production with an average productivity of 476.1 kg ha^{-1}.

The factors attributed for low yields of pulses in India as compared to the world productivity are non- availability of quality seeds of improved and short duration varieties, growing of pulses under marginal and less fertile soil with low inputs and without pest and disease management, growing of pulses under moisture stress, unscientific post harvest practices and storage under unfavourable conditions. Hence, there is a scope for improving the production potential of this crop by use of organic manures, inorganic manures and biofertilizers (Vadgave, 2010) [21]. Integrated nutrient management includes the intelligent use of organic, inorganic, and on-line biological resources so as to sustain optimum yields, improve or maintain the soil physical and chemical properties, and provide crop nutrition packages which are technically sound, economically attractive, practically feasible and environmentally safe. The existing state blanket recommendation for crops does not ensure efficient and economic use of fertilizers, as it does not take into account the fertility variations resulting in imbalanced use of fertilizer nutrients. Among the various methods of fertilizer recommendations, the soil test based fertilizer recommendations is also appropriate practices to improve yield as well as soil nutrient status (Gayathri *et al*., 2009) [4].

Urdbean is one of the most important pulse crops of India cultivated over a wide range of agro-climatic situations. The major urdbean growing states of the country are Maharashtra, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamilnadu, Karnataka and Rajasthan.

Leguminous crops are also responsive to balance dose of nutrient just like any other crop. Nutrient imbalance was one of the major abiotic constraints limiting productivity of pluses Masood *et al*. (2000) [9]. Application of biofertilzer recorded the the highest value of growth and yield attributes and yield of urdbean. It was observed that the plants treated with experimental biofertilizer Rhizobium showed excellent result in the morphological and bio-chemical parameters (Nalawde and Bhalerao, 2015) [11]. Application of FYM increases N,P,K content due to outcome of increased availability of nutrients to the plant upon decomposition of applied FYM (Vasanthi and Subramanian, 2004) [23]. FYM @ 5 t ha^{-1} in urdbean crop increase the available potassium content of soil after harvest of urdbean crop. The higher availability of potassium due to FYM may be ascribed to the reduction of K fixation and release of K due to the interaction of organic matter with clay (Tandon, 1987, Jagadeeshwari and Kumaraswamy (2000) [20, 6]. Application of biofertilzer recorded the the highest value of growth and yield attributes and yield of urdbean. It was observed that the plants treated with experimental biofertilizer Rhizobium showed excellent result in the morphological and bio-chemical parameters (Nalawde and Bhalerao, 2015) [11]. Inoculation of urdbean seed with biofertilizer enhances available P status of soil by solublizing bound phosphate into available forms (Singh *et al*, 2008) [19].

Materials and methods

The study was carried out at experiment field of Instructional cum Research Farm, Indira Gandhi Krishi Vishvavidhyalaya, Raipur, Chhattisgarh during *kharif* season of 2017-18. To study the effect of fertilizer doses, organic manure and biofertilizers on yield attributes and yield of urdbean (*Vigna mungo* L.). The soil of the experimental field was Vertisols with low, medium and high in N, P and K, respectively and neutral in reaction. The climate of the region is sub-humid to semi-arid. The experiment was laid out in Factorial Randomized Block Design having the combination of sixteen treatments and three replications. The treatment consisted of four levels of fertilizer doses that is F_1 -75%, F_2-100%, F_3 - 125% and F_4 -150% RDF, two levels of organic manure control and 5 t FYM ha^{-1} and two levels biofertilizer rhizobium and LMn-16. Variety Indira urd Pratham was sown 18th July, 2017 with a seed rate of 20 kg ha^{-1}. The crop was harvested on 19th September 2018.

Result and discussion

Yield attributes

Number of pods plant^{-1}

Plant growth behavior can be determined by number of pods plant^{-1}. Both remobilization of N and biological N_2 fixation during reproductive growth are important sources of N for developing pods (Neves *et al.*, 1990) [12]. Number of pods plant^{-1} depends on the number of flowering nodes plant^{-1}, branches plant^{-1} and number of flowers pod^{-1} and its retention. Greater photosynthesis enhanced by more nutrient uptake helps to initiate more flowering buds, which ultimately developed as pods. The number of pods plant^{-1} influenced significantly due to seed rate and nutrient levels.

The nutrient requirement of a plant depends on its demand and is controlled genetically or by the nutrient status present in soil. The number of pods plant^{-1} significantly increased with increasing levels of nutrient. Plant fertilized with 125 % RDF produced the highest number of pods plant^{-1} (24.68), however, 100% RDF found comparable with this and the lowest number of pods plant^{-1} (20.22) was recorded from the plants fertilized with 75 % RDF. During pod development the supply of sufficient nutrient and photo assimilates are essential for increasing pod length as well as seed number in pod. The increase in number of pods plant^{-1} was probably due to balanced plant growth and better fruiting caused by optimum neutralization of NPK. Insufficient nutrient supply at the time of flowering and pod development stage may cause lesser number of pods plant^{-1}. Application of RDF recorded significantly more number of pods plant^{-1} over rest of the treatments. Phosphorus plays vital role productive phase of the crop. It enhances carohydrate synthesis and rate of metabolic activities through increased leaf area and its efficient utilization in protein synthesis resulting in more number of developed pods plant^{-1}.These results are in conformity with the findings of Rajkhowa (2002) [14], Rudreshappa and Halikatti (2002) [15], Yakadri *et al*. (2002) [24] and Rathore *et al.* (2010) [13].

As regards to FYM, significantly higher number of pods plant^{-1} (26.63) was recorded under 5t FYM ha^{-1} than control. The effect of bio-fertilizer was found non significant over the treatments.

The interaction effect of fertilizer doses and organic manure showed significant influence on number of pod plant^{-1} of urdbean. Maximum number of pods plant^{-1} (28.9) was noted under interaction of 100%RDF with 5t FYM ha^{-1}. However, it was found at par to interection between 75%RDF with FYM 5t ha^{-1} and 125% RDF with 5t FYM ha^{-1}. The application of adequate quantity of fertilizer through organic and inorganic sources leads to cell division, cell elongation and tissue differentiation.

Number of seeds pod^{-1}

The number of seeds pod^{-1} is one of the key factors determining the final seed yield. Data on number of seeds pod^{-1} is presented in Table 1. Perusal of the data show that fertilizer doses, organic manure and bio-fertilizers did not cause significant variations with respect to number of seeds pod^{-1}.

The interaction effects of fertilizer doses, organic manure and bio-fertilizers with respect to number of seeds pod^{-1} were also found non-significant.

100-seed weight (g)

The final seed yield is a function of combined effect of the individual yield components nourished under applied inputs and 100-seed weight is an important yield determining factor. It expresses the magnitude of seed development for deriving the seed quality and yield per hectare. Thus, seed size *i.e.*, seed weight contributes greatly to seed yield.

Table 1: Effect of fertilizer doses, organic manure and biofertilizers on yield attributes of urdbean

Treatment	Pods plant^{1} (no.)	Seeds pod^{-1} (no.)	100- seed Weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Fertilizer doses (%RDF)						
F_1 75	20.22	6.25	3.88	706.20	1340.83	28.95
F_2 100	24.62	6.58	4.13	829.49	1573.17	34.28
F_3 125	24.68	6.67	4.13	831.05	1578.75	34.40
F_4 150	21.53	6.33	3.89	742.96	1410.83	31.57
SEm±	0.81	0.16	0.12	22.70	42.60	1.99
CD (P=0.05)	2.34	NS	NS	65.49	122.91	NS
FYM (t ha^{-1})						
M_1 0	18.90	6.33	3.76	669.17	1270.17	31.99
M_2 5	26.63	6.58	4.26	885.68	1681.63	32.61
SEm±	0.57	0.12	0.08	16.05	30.13	1.41
CD (P=0.05)	1.65	NS	0.24	46.31	86.91	NS
Biofertilizers						
B_1 Rhizobium	22.92	6.50	4.02	7781.69	1484.38	33.78
B_2 LMn-16	22.61	6.42	4.00	7 773.16	1467.42	30.81
SEm±	0.57	0.12	0.08	16.05	30.13	1.41
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Interection	S	NS	NS	S	S	NS

Note:- RDF- 20:50:20:20 kg N:P_2O_5: K_2O:S ha^{-1}

Table 2.1: Interection effect of fertilizer doses and FYM on numbers of pods plant^{-1} of urdbean

Treatment	Pods plant^{-1} (no.)		
F x M		**FYM (t ha^{-1})**	
	M_1-0	M_2-5	Mean
Fertilizer doses (%RDF)			
F_1 75	14.6	26.0	20.22
F_2 100	20.3	28.9	24.62
F_3 125	22.3	27.1	24.68
F_4 150	18.4	24.7	21.53
Mean	18.90	26.63	
SEm ±	1.15		
CD (P=0.05)	3.31		

Table 2.2: Interection effect of fertilizer doses and FYM on seed and stover yield (kg ha^{-1}) of urdbean

Treatment	Seed yield (kg ha^{-1})			Stover yield (kg ha^{-1})		
F x M	**FYM (t ha^{-1})**			**FYM (t ha^{1})**		
	M_1-0	**M_2-5**	**Mean**	**M_1-0**	**M_2-5**	**Mean**
Fertilizer doses (%RDF)						
F_1 75	548.00	864.00	706.20	1042.00	1639.00	1340.83
F_2 100	709.50	949.50	829.49	1346.50	1800.00	1573.17
F_3 125	764.50	897.50	831.05	1450.00	1707.00	1578.75
F_4 150	654.50	831.50	742.96	1242.50	1574.00	1410.83
Mean	669.17	885.68		1270.17	1681.63	
SEm ±	32.1			60.3		
CD (P=0.05)	92.60			173.8		

Yield

Seed yield (kg ha^{-1})

The highest seed yield (831.05 kg ha^{-1}) was observed under 125 % RDF which was significantly higher over 75% and 150% RDF but at par with 100% RDF. The increase in the seed yield ha^{-1} of urdbean owing to increase in the fertility level was due to the fact that application of adequate of nutrients in the balanced proportion enhanced the growth of the crop and better utilization of soil moisture and other resources led to better development of the yield attributes. Moreover the improvement in yield attributes and consequent to higher yield might possibly be due to the enhanced synthesis of carbohydrates and proteins and their transport to the sink through efficient physiological activities in plants, as evident from improved physiological parameters like LAI and CGR. Higher seed yield of urdbean was mainly owing to significantly superior yield attributes like effective number of pods plant^{-1} and 100-seed weight. Our result enlightened with the findings of Rathore *et al.* (2010) [13], Shete *et al.* (2010) [18]. Higher seed yield may be attributed due to greater partitioning of dry matter into the economic portion i.e., to seed and favorable growth nutrient uptake, higher number of seeds plant^{-1} and heavier seed weight (Kuslam *et al.*, 2007) [8]. Significantly maximum seed yield (885.68 kg ha^{-1}) was obtained with application of organic manure FYM 5 t ha^{-1} over control. The marked increase in seed yield due to beneficial effect of FYM has been also reflected in various growth and yield attributes like plant height and number of branches. The above finding is in complete agreement with Ghanshyam and Jat (2010) [5], Sharma and Abraham (2010) [16], Shete *et al*. (2011) [17], Tomar *et al*. (2013) [22] and Kokani *et al*. (2015) [7].

While, effect of biofertilizers was found non-significant for seed yield of urdbean. Seed yield was significantly influenced by the interaction effect of fertilizer doses and organic manure (FYM) (Table 2.2). Fertilizer doses and organic manure

(FYM) Interaction showed that significantly highest seed yield was obtained under 100% RDF with 5 t FYM ha^{-1}, although it was at par to 75%RDF with 5 t FYM ha^{-1} and125% RDF with 5 t FYM ha^{-1}. It is possible with the application of RDF+FYM placement in rows @ rate of 5 t ha^{-1}due to that NPK application along with FYM placement with rows, application of FYM to the crop improving the overall fertility status of the soil, vigorous plant growth might have produced more photosynthetic. Efficient partitioning of accumulated photosynthesis, enhanced yield attributes which ultimately increased the seed yield. Similar observations were noted by Delesa and Choferie (2015) [3].

Stover yield (kg ha^{-1})

Biological or stover yield is a measure of total dry matter production of crop during its life span. The data on stover yield of urdbean (Table 1) indicated that different treatments had significant effects on the stover yield.

Application of fertilizer doses significantly affected the stover yield, maximum (1578.75 kg ha^{-1}) being recorded in the treatment receiving 125 % RDF which was found comparable with 100%RDF (1573.17), while minimum stover yield (1340.83 kg ha^{-1}) was obtained with 75 % RDF. The increase in stover yield is due to increase in plant height and dry matter production at higher nutrient levels. The presence of adequate amount of major nutrients in the soil might have enabled the plant to fix nitrogen from the atmosphere in nodules which improved the plants growth and its development, which is the probably responsible for increased stover yield. The increase in straw yield with application RDF might have attributed to the higher photosynthetic activity in urdbean plant leading to a better supply of carbohydrates resulted in more number of branches and dry matter. Similar findings were also reported by Mishra and Mishra (1995) [10].

Significantly maximum stover yield (1681.63 kg ha^{-1}) was obtained with application of 5 t FYM ha^{-1}. The marked increased in seed and stover yield due to beneficial effect of FYM on various growths and yield attributes like plant height and number of branches and finally their cumulative effect on yield. The above finding is in complete agreement with Ghanshyam and Jat (2010) [5], Sharma and Abraham (2010) [16], Shete *et al*. (2011) [17] and Tomar *et al*. (2013) [22] and Kokani *et al*. (2015) [7]. While, effect of biofertilizers was found non-significant for stover yield of urdbean. Stover yield was significantly influenced by the interaction effect of seed fertilizer doses and organic manure (FYM) (Table 2.2). Fertilizer doses and organic manure (FYM) interaction showed that significantly highest stover yield (1800 kg ha^{-1}) was obtained under 100%RDF with FYM 5 t ha^{-1}. However, it was found at par with interection between 75% RDF with 5t FYM ha^{-1} and 125% RDF x 5 t FYMha $^{-1}$. However, lowest stover (1042 kg ha^{-1}) yield was found in interaction between 75%RDF with control.

Harvest index (%)

The data on harvest index for different treatments have been presented in Table 2.2. Harvest index is a measure of physiological productivity potential of crop. It is the ability of a plant to convert the dry matter into economic yield. Among fertilizer doses, no significant difference was observed on harvest index. However, maximum harvest index was observed with the 125%RDF. Application of 75%RDF showed the lowest harvest index.

Application of organic manure did not give significant difference for harvest index. However, maximum harvest index was observed with the application of FYM 5 t ha^{-1}. Effect of biofertilizers was also found non-significant for harvest index. The interaction effects of fertilizer doses, organic manure and bio-fertilizers with respect to harvest index were found non-significant differences.

Conclusions

Urdbean crop responded well to the application of nutrient as the soils of the experiment field was average in nutrient status *viz.*, low in organic carbon content (0.31 %), low in available nitrogen content (216.6 kg ha^{-1}), medium in available phosphorus (11.4 kg P_2O_5 ha^{-1}) and high available potassium (361.2 kg ha^{-1}) contents. Seed yield of urdbean differed significantly due to different nutrient levels. Application of 125% RDF followed by 100 % RDF and 5 t FYM ha^{-1} recorded significantly highest on yield attributes and yield of urdbean.

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