Environment and Ecology 41 (1B) : 411—415, January—March 2023
ISSN 0970-0420

Performance of Cowpea *(Vigna unguiculata* L.) Varieties for Flowering and Seed Quality Under Integrated Nutrient Management Practices

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Received 2 October 2022, Accepted 17 December 2022, Published on 6 March 2023

ABSTRACT

A field experiment was conducted during *rabi* season, 2015-16 at Department of Vegetable Science, College of Horticulture, Mandsaur (Madhya Pradesh) to evaluate the cowpea varieties to integrated nutrient management practices. The experiment was arranged in factorial Randomized Block Design with twenty treatment combinations comprising four cowpea varieties, viz. V_1-Pusa Sukomal, V_2-Kashi Unnati, V_3-Kashi Kanchan and V_4-Kashi Shyamal and five integrated nutrient management (INM) practices, viz. N_1-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (0 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha, N_2-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (15 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha; N_3-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (20 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha, N_4-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (25 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha and N_5-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha. In present experiment the cowpea variety Pusa Sukomal recorded superior performance for flowering and quality attributes. This variety had taken minimum days to first flowering, days to 50% flowering and days to harvesting. The study revealed that the application of Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ haproved significantly superior over rest of treatment combinations and provided significantly higher test weight (16.44 g), germination percentage (95.83) and crude protein content (25.76%) in cowpea seed.

Keywords Cowpea, Vermicompost, Seed quality, Biofertilizer, Quality attributes.

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INTRODUCTION

Cowpea (*Vigna unguiculata* L.) belongs to the family Leguminoceae and having chromosome number 2n=22 with genus *Vigna*. It is originated from Central Africa and mainly cultivated in Asia, Africa, Central and South America. Leguminous crops play an im-

Table 1. Details of experimental treatments. PSB- Phosphate Solubilizing Bacteria.

Notations	Treatments
Varieties (V)	
V_1	Pusa Sukomal
V_2	Kashi Unnati
V_3	Kashi Kanchan
V_4	Kashi Shyamal
Nutrient levels (N)	
N_1	Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (0 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha
N_2	Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (15 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha
N_3	Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (20 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha
N_4	Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (25 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha
N_5	Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha

portant role in Indian Agriculture. They have unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrient and bringing qualitative changes in soil. The countries like Bangladesh, China, India and Indonesia are the major cowpea growing countries in Asia. In India it is grown in the states like Rajasthan and adjoining a part of Himachal Pradesh have a good acreage under this crop (Das *et al.* 2011). Cowpea is well adapted to stress condition and possesses excellent nutritional quality. Its 100 g ediblegreen pods contain 84.6 g moisture, 4.3 g protein, 0.2 g fat, 0.9 g minerals, 2.0 g fiber, 8.0 g carbohydrates. It plays an important role by serving as pulse (dry seeds) as well as vegetable (green pod) in subtropical regions.

In India, cowpea is known since Vedic times. It is grown widely throughout the year for all forms- tender pods, dry seeds, fodder, green manure and cover crops both as sole and mixed crop. Cowpea fixes atmospheric N up to 240 kg/ha and leaves about 60-70 kg residual N for succeeding crops. Thus, cowpea is one of the most essential vegetable crops in organic farming systems as it contributes to the sustainability of cropping systems and soil fertility improvement even in marginal lands through provision of ground cover, plant residue, nitrogen fixation and suppressing weed. Addition of organic materials is a common practice in a hill agro-ecosystem. Besides plant nutrients, the presence of enzymes and hormones in manure make them essential for improvement of soil fertility and productivity. Cowpea requires good quantity of nutrients throughout the growth periods especially P for better development of roots, better nodulation and N-fixation. Moreover, in early stages, plant requires N for better germination, production of more branches and peduncles resulting in greater number of pods, seeds and significantly higher yields (Abayomi *et al*. 2008).

MATERIALS AND METHODS

The experiment was carried out during *rabi* season, 2015-16 at Research Field of the Department of Vegetable Science, College of Horticulture, Mandsaur (Madhya Pradesh). Mandsaur is situated in Malwa Plateau in Western part of Madhya Pradesh at 23.45° to 24.13° North latitude and 74.44° to 75.18° East longitudes and an altitude of 435.02 meters above mean sea level. The topography of the experimental field was plain. This region lies under 10th Agro climatic zone of the state. Soil of the experimental field was light alluvial having sandy loam texture with low (192 kg/ha) nitrogen, medium (19.30 kg/ha) phosphorus, high (694 kg/ha) available potassium, 0.46 dSm^{-1} electrical conductivity and slightly alkaline in reaction (pH 7.5). The experiment was laid out in factorial Randomized Block Design with twenty treatment combinations comprising four cowpea varieties, viz. V_1 (Pusa Sukomal),V_2 (Kashi Unnati), V_3 (Kashi Kanchan) and V_4 (Kashi Shyamal) and five integrated nutrient management (INM) practices, viz. N_1-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (0 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha, N_2 -Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (15 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha; N_3 -Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (20 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ ha; N_4 Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) +PSB (10 g/kg of seeds) + N (25 kg) + P_2O_5

Table 2. Effect of varieties and nutrient levels on flowering and quality of cowpea.

Treatments	Days to first flower initiation	Days to 50% flowering	Days to harvesting	Test weight (g)	Germination (%) of seed	Crude protein content (%) in seed
Varieties (V)						
V_1 (Pusa Sukomal)	32.71	39.47	67.29	16.17	96.50	25.05
V_2 (Kashi Unnati)	34.72	41.94	69.50	13.67	91.00	22.84
V_3 (Kashi Kanchan)	35.39	42.55	70.56	13.15	93.97	21.73
V_4 (Kashi Shyamal)	34.09	41.31	69.26	14.41	92.60	22.97
SEm±	0.45	0.57	0.57	0.49	0.65	0.69
CD (P<0.05)	1.30	1.64	1.62	1.40	1.86	1.99
Nutrient levels (N)						
N_1	32.57	38.50	65.82	12.72	91.71	20.98
N_2	33.14	39.81	67.93	13.39	92.58	21.96
N_3	33.80	41.57	69.56	14.17	93.33	23.19
N_4	34.99	42.38	70.37	15.03	94.13	23.85
N_5	36.63	44.34	72.09	16.44	95.83	25.76
SEm±	0.41	0.51	0.51	0.44	0.58	0.62
CD (P<0.05)	1.16	1.46	1.45	1.26	1.67	1.78

(90 kg) + K_2O (70 kg)/ha and N_5-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha (Table 1).

The size of plot was 2.7 m × 2.4 m. The calculated quantities of fertilizers were applied to the each plot with the use of nitrogen (DAP, Urea), phosphorus (DAP), potash (MOP). Half dose of nitrogen and full dose of phosphorus and potash were applied as basal dose prior to sowing of cowpea seeds, while the rest of nitrogen was given at 30 days after sowing. Vermicompost was applied as basal at the time of sowing. PSB and 1 strain of *Rhizobium* phaseoli (obtained from IARI) were mixed and applied through seed treatment. Other intercultural operations and crop management practices were carried out in accordance with the recommended package of practices. The pure, healthy, disease and insect free vigorus and good quality cowpea seeds (Pusa Sukomal, Kashi Unnati, Kashi Kanchan and Kashi Shyamal) were used for sowing. Seeds were sown at a depth of 3-4 cm in lines at a spacing of 45 × 15 cm. Weeding was done thrice manually at 25, 45, and 60 days after sowing with the help of khurpi. First light irrigation was done just after sowing then subsequent irrigations were applied as per the requirement of the crop.The data obtained on various observations for each treatment were statistically analyzed as per the standard procedure.

RESULTS AND DISCUSSION

Phenological parameters of cowpea

Results of phonological parameters (Table 2) indicate significant effect of varieties on days to first flower initiation. Earliest first flower initiation (32.71 days) was commenced in variety V_1 (Pusa Sukomal) followed by V_4 (Kashi Shyamal), V_2 (Kashi Unnati) and V_3 (Kashi Kanchan). Genetic constitution of variety V_1 (Pusa Sukomal) might be responsible for earliest flower initiation. These finding are in line with Pandey *et al.* (2006). There was significant effect of nutrient levels on days to first flower initiation. Application of nutrient levels caused significant influence on days to first flowering. Delay in appearance of first flowering with higher doses of nutrients was observed. Maximum days to first flower initiation (36.63 days) were taken under nutrient level N_5. Nitrogen promotes the vegetative growth and delay the flowering in plants.

These results are in close conformity with findings of Satodiya *et al*. (2015).

The findings revealed that significant effect of varieties and nutrient levels on days to 50% flowering in cowpea (Table 2). Earliest 50% flowering (39.47 days) was commenced in variety V_1 (Pusa Sukomal). It was followed by V_4 (Kashi Shyamal), V_2 (Kashi Unnati) and V_3 (Kashi Kanchan). Genetic constitution of variety V_1 (Pusa Sukomal) might be responsible for earliest 50% flowering. These results could be attributed to earlier first flower appearance resulting in earlier 50% flowering. Similar results have been reported by Kwaga (2014) and Babaji *et al.* (2011). Application of nutrient levels caused significant influence on days to 50% flowering. Higher levels of nutrient resulted in delay of flowering. Maximum days to 50% flowering (44.34 days) were taken with application of N_5 nutrient level which was significantly higher over other nutrient levels. Higher nutrient levels provide more nitrogen which could be the reason of delayed flowering. These results are line with the observation of Satodiya *et al.* (2015).

The earliest harvesting stage (67.29 days) was observed in variety V_1 (Pusa Sukomal). It was followed by V_4 (Kashi Shyamal), V_2 (Kashi Unnati) and V_3 (Kashi Kanchan). Significantly higher number of days to harvesting stage (70.56) was taken by variety V_3 (Kashi Kanchan). The results are in agreement with Babaji *et al.* (2011). Application of nutrient levels caused significant influence on days to harvesting stage. There was delay in appearance of harvesting stage with higher doses of nutrients. Maximum days to harvesting (72.09) were taken under N_5 nutrient level while, minimum days to harvesting (65.82) were taken with N_1 nutrient level.

Quality parameters of cowpea

Maximum value for test weight i.e. 16.17 g (Table 2) was recorded with variety V_1 (Pusa Sukomal). It was followed by V_4 (Kashi Shyamal) and V_2 (Kashi Unnati), while minimum test weight (13.15 g) was found under variety V_3 (Kashi Kanchan). Increase in seed weight might be due to greater accumulation of plant metabolites in the seed at pod filling stage (Yadav 2012). Kwaga (2014) remarked that weight is genetically controlled. Pawar *et al.* (2007) also reported the similar results in french bean. Nutrient levels exerted significant effect on test weight. There was increase in test weight with increase of nutrient levels. Maximum test weight (16.44 g) was recorded with N_5 which was significantly higher than other nutrient levels, while minimum test weight (12.72 g) was recorded under nutrient level N_1. Similar results were obtained by Abdelhamid *et al.* (2011) and Salehin and Rahman (2012).

Highest germination percentage (96.50) was recorded with variety V_1 (Pusa Sukomal). It was followed by V_3 (Kashi Kanchan) and V_4 (Kashi Shyamal). Minimum germination percentage (91.00) was found under variety V_2 (Kashi Unnati). Germination percentage indicated significant effect of nutrient levels in cowpea. There was increase in germination percentage with increase nutrient level. Maximum germination percentage (95.83) was recorded with nutrient level N_5, probably due to better development of seed with optimum availability of nutrients. It was followed by $N_4 > N_3 > N_2$ nutrient levels under study while minimum germination percentage (91.71) was observed under N_1.

Among the varieties, maximum crude protein (25.05%) content in seed (Table 2) was found in variety V_1 (Pusa Sukomal). It was followed by V_4 (Kashi Shyamal) 22.97% and V_2 (Kashi Unnati) 22.84%. Lowest crude protein content (21.73%) in seed was noted in case of variety V_3 (Kashi Kanchan). Nutrient levels exerted significant influence on crude protein content in seed. Maximum crude protein content (25.76 %) in seed was observed with application of nutrient level N_5. Optimum availability of nutrient under N_5 might have promoted these attribute. It was significantly higher than N_4, N_3 and N_2. While minimum crude protein content (20.98 %) in seed was recorded under N_1. Higher nitrogen in seed is directly responsible for higher protein because it is a primary component of amino acids which constitute the basis of protein (Choudhary *et al.* 2013). Probably higher dose of fertilizers fortified with vermicompost helped in a more efficient translocation of nitrogen from vegetative parts to the developing seeds as well as synthesis of protein (Kumar *et al.* 2006). The more N uptake under more nitrogen applied plots has increased protein formation (Bagal and Jadhav 1995). These results are in close conformity with the findings of Jadhav *et al.* (2011).

CONCLUSION

On the basis of present experiment, it may be concluded that variety V_1 (Pusa Sukomal) recorded superior performance for phenological and quality attributes. Variety V_1 (Pusa Sukomal) had taken minimum days to first flowering, days to 50% flowering and days to harvesting where as variety V_3 (Kashi Kanchan) had taken maximum days. Among the nutrient levels N5{Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha} resulted in the highest quality parameters of cowpea seed. Though, it caused delay in commencement of first flower initiation, 50% flowering and harvesting.

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