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Vermiwash Prepared from Different Combination of Organic Sources to Improve Growth and Yield of Blackgram [*Vigna mungo* (L.) Hepper] for Organic Agriculture

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ABSTRACT

Background: Black gram (*Vigna mungo*) is one of the most important pulse crops grown throughout the country. It is hardy crop and fixes nitrogen in soil. Organic black gram fetch higher price in market *i.e.*, Rs. 175 whereas other receive Rs. 120. Vermiwash, is one among the organic manures which has high potential to increase the crop growth and yield. Thus, present study aims to evaluate the influence of vermiwash prepared from different combination of organic sources on growth and yield of black gram.

Methods: The field experiment was conducted during *kharif*, 2018 at Organic Farming Unit, Rajasthan College of Agriculture, Udaipur**,** with nine treatments [T_1= vermiwash from 100% cow dung, T_2= vermiwash from 100% buffalo dung, T_3= vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste, T_4= vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste, T_5= vermiwash from 90% green waste incubated with 10% cow dung, T_6= vermiwash from 90% green waste incubated with 10% buffalo dung, T_7= vermiwash from 90% dry waste incubated with 10% cow dung, T_8= vermiwash from 90% dry waste incubated with 10% buffalo dung and T_9= water spray (control)] and were replicated thrice in Randomize Block Design.

Result: The result of experiment revealed that the application of vermiwash from 100% cow dung significant influence towards growth parameters and yield attributes thus achieved maximum seed yield, haulm yield and B:C ratio (2.3). On the basis of field performance, it may be concluded that the treatment T_1(top dressing in two equal split application at the rate of 10% at initiation of flowering and 15 days after 1st spray) may be recommended as a better organic package of blackgram.

Key words: Blackgram, Organic sources, Seed yield, Vermiwash.

INTRODUCTION

Green Revolution Technologies (GRTs) led to emergence of India as self-sufficient as well as exporting country in terms of food grains but nutritional security remains a cause of concern. India has around a quarter of the world's undernourished population (Sharma *et al.,* 2016). This emphasises the significance of pulses in the Indian population's food and nutrition welfare. The pulses are a valuable source of dietary protein, energy, minerals and vitamins to overcome malnutrition among human beings and their significance in improving soil quality through atmospheric nitrogen fixation, organic matter addition and environment safety. According to 3rd advance estimates of production of major crops for 2019-20, India produced 23.02 million ton of pulses, which is 23.62% of the world output, with chickpea covering the highest area, followed by pigeonpea, urdbean, mungbean, lentil, pea etc. Among the pulses, blackgram or urdbean [*Vigna mungo* (L.)] is the fourth most important pulse crop cultivated throughout India for its multipurpose uses as vegetable, pulse, fodder and green manure crop. During 2019-20, India has coverage of 36.44 lakh hectare producing 17.23 lakh tonne of blackgram production. In Rajasthan, it is cultivated in 5.02 lakh hectares with 1.28 lakh tonnes production (Anonymous, 2020-21). It is a good source of protein (25-28%), oil (1.0 -1.5%), fibre (3.5 - 4.5%), ash (4.5 - 5.5%) and carbohydrates (62 - 65%) on dry weight basis. It is a good source of minerals, vitamins A, B_1, B_3 and ascorbic acid (Sharma *et al.* 2011). Being a drought resistant, short duration, photo-insensitivity and dense growing crop, it is suitable for dry land farming and predominantly used in crop intensification and diversification; conservation of natural resources and sustainability of production system. When compared to global average yields, most pulses in India have a lower productivity because of their cultivation on marginal and sub-marginal land with poor soil fertility as well as poor fertilizer and water management. Another major problem that excessive, unbalanced and imprecise chemical fertilisation in the process of attaining higher productivity per unit area, resulted

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in declining soil fertility and productivity, large-scale degradation of soil and water resources, adverse effects on beneficial soil microflora and native bio-diversity and wide-spread problems associated with the toxic residues of agro-chemicals entering into the human and animal food chains (Prasad and Gill, 2009). Modern agriculture has become increasingly unsustainable, scientists go for searching the alternatives and the most well-known alternative to conventional farming is organic farming. It confers sustainability to crop production and also maintains soil nutrient dynamics and safe environment, whereas the crop rotation of cereals with pulses provides long term sustainable farming system and the response of pulses to organic nutrient management is encouraging (Sharma *et al*. 2017). In organic agriculture, liquid manure plays an important role in boosting crop yields while lowering solid manure uses which are required in bulk amount, having low content of nutrients and very slow rate of nutrients release, whereas liquid manure having high content of total nutrients and quick acting on plants. Vermiwash is nutrients rich liquid manure produced by earthworms, feeding on organic waste material and plants residues. It is a non-toxic and eco-friendly liquid manure which contains macro (N, P, K) and micro-plant elements and hormones such as auxin, cytokinine, enzymes, antibiotics, minerals, vitamins and many useful microbes like heterotrophic bacteria, fungi etc. (Edwards and Burrows, 1988; Buckerfield *et al*.,1999; Tripathi and Bhardwaj,2004; Zambare *et al.,* 2008). The quality of vermiwash produced by earthworms depends on different vermicomposts used that are prepared from different farm and animal wastes (Rai and Bansiwal, 2008; Nath and Singh, 2012).

Hence, the present investigation was undertaken to study the effect of vermiwash prepared from different combination of organic sources on growth and yield of blackgram.

MATERIAL AND METHODS

The experiment was carried out at Organic Farming Unit, Rajasthan College of Agriculture, Udaipur, situated at South-Eastern part of Rajasthan at a height of 582.17 m above mean sea level and at 24°35' N latitude and 73°42' E longitude to study the effect of vermiwash on blackgram during *kharif*, 2018.During the crop growing season, the average maximum and minimum temperature ranged between 27.9 to 32.2°C and 21.0 to 24.0°C, respectively. The average rainfall is 488.8 mm, 75% of which is received from June to September. The texture of experimental soil was clay loam, slightly alkaline in reaction, low in available nitrogen, medium in available phosphorus and potassium as well as high in calcium carbonate. The experiment was laid down randomised block design with three replication comprising nine treatments *i.e.* (T_1= vermiwash from 100% cow dung, T_2 = vermiwash from 100% buffalo dung, T_3= vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste, T_4= vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste, T_5= vermiwash from 90% green waste incubated with 10% cow dung, T_6= vermiwash from 90% green waste incubated with 10% buffalo dung, T_7= vermiwash from 90% dry waste incubated with 10% cow dung and T_8= vermiwash from 90% dry waste incubated with 10% buffalo dung and T_9= control). Vermiwash was prepared from different organic sources i.e., cow dung, buffalo dung, green and dry farm waste, by using earthen pot method in which an earthen pot of 10 liter capacity with a hole at the base was taken and a rubber pipe was fixed in the hole. First of all, a thin layer of coarse sand is laid in the pot; above the sandy layer, 15-20 cm thick layer of 15- 20 days old cow dung was placed which followed by 15 cm thick layer of farm green or dry waste. The layers of cow dung and farm waste was repeated until the pot was filled. Water is sprinkled in between the layers to provide moisture. About 1000 epigenic earthworms (*Eisenia foetida*) mixed with the feed. One more pot filled with water is placed above it so that drop wise water enters into the vermicompost pot. Third pot was placed below it. Assembly of these three earthen pots was hanged at a shady place. The vermiwash was collected in the third pot in between 30-35 days of period and use as foliar spray in dilution with water. Each plot had an area of 4.0 m × 3.0 m. The treated seeds of black gram with rhizobium culture were sown with a spacing of 30 cm X 10 cm. The crop was fertilized as basal dose in form of 4 t of FYM ha^{-1}, rest was applied through vermiwash liquid manures as top dressing in 2 equal splits at the rate of 10% at the initiation of flowering and 15 days after 1^{st}spray to all treatments except control. Necessary field operations like irrigation, weeding and disease-pest management were done as and when needed. Pods were harvested by manually picking when pods turn black/dark brown. Growth parameters *viz*. plant height, dry matter accumulation $plant^{-1}$ was recorded at45 and 60days after sowing (DAS). Yield components namely number of pods $plant^{-1}$, number of seeds pod^{-1}, test weight and seed yield and haulm yield were recorded at harvest. To find out the more profitable treatment, economics of different treatments were worked out in terms of B:C ratio on the basis of prevailing market rate so that the remunerative treatment could be recommended.

The data was subjected to statistical analysis of variance as outline by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

All the treatments except control significantly influenced growth parameters of blackgram. Plant height and dry matter accumulation increased consistently with the advancement of crop growth stages *i.e.*, 45to 60 DAS (Table 1). Among the different treatments, application of vermiwash from 100% cow dung recorded significantly higher plant height (31.3 and 39 cm) and dry matter production (3.5 and 6.83 g $plant^{-1}$) at 45 and 60 DAS, respectively. This might be due to influence of vermiwash as a potential source of macro and micronutrients, enzymes, vitamin and growth hormones like gibberellins *etc*. that have created stimuli in the plant system and increased the production of growth regulators in the cell which stimulated the growth and development of plant. Similar results were obtained by Maya and Satish, 2015. It is an established fact that foliar application of vermiwash in blackgram crop supplies almost all the essential plant nutrients for the growth and development of plants. The present findings were accordance with the earlier reports of Subha *et al.,* 2003; Kauri and Kauri, 2017; and Rekha *et al.,* 2013. Blackgram yield potential is determined by yield components and the values of yield components were in accordance with that of growth parameters. Dry matter accumulation supported the seed yield and have positive correlation with seed yield (Fig 1). There was significant influence on yield attributes and yield of blackgram grown

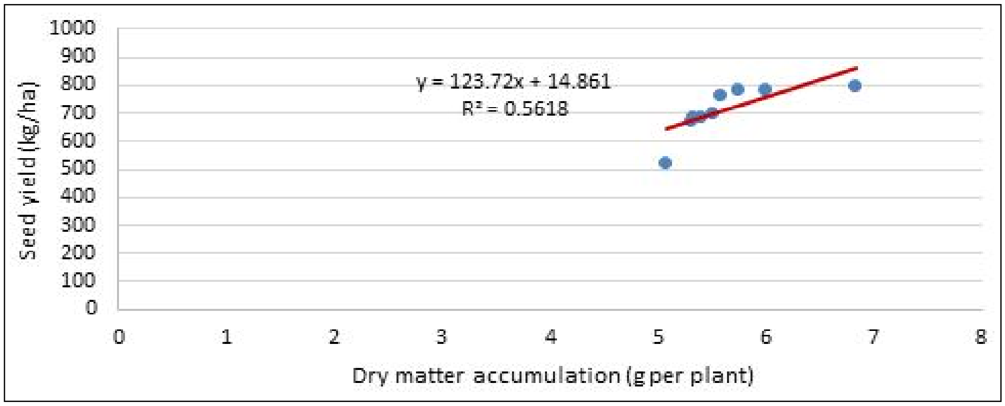

Fig 1: Correlation between dry matter accumulation (g plant^{-1}) and seed yield (kg ha^{-1}).

Table 1: Effect of vermiwash from different organic sources on growth parameters of blackgram.

Treatments	Plant height (cm)		Dry matter accumulation (g plant^{-1})	
	45 DAS	60 DAS	45 DAS	60 DAS
T_1. Vermiwash from 100% cow dung	31.3	39.0	3.50	6.83
T_2. Vermiwash from 100% buffalo dung	28.3	35.7	3.33	5.73
T_3. Vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste	29.3	36.0	3.45	6.00
T_4. Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste	27.3	35.0	3.30	5.57
T_5. Vermiwash from 90% green waste incubated with 10% cow dung	27.3	34.7	3.30	5.50
T_6. Vermiwash from 90% green waste incubated with 10% buffalo dung	27.0	34.3	3.28	5.40
T_7. Vermiwash from 90% dry waste incubated with 10% cow dung	26.7	33.3	3.27	5.33
T_8. Vermiwash from 90% dry waste incubated with 10% buffalo dung	26.3	32.3	3.22	5.30
T_9. Water spray (Control)	25.3	31.7	3.10	5.07
S.Em±	0.4	0.6	0.05	0.14
CD (P = 0.05)	1.1	1.8	0.16	0.42

Table 2: Effect of vermiwash from different organic sources on yield attributes of blackgram.

Treatments	Yield Attributes		
	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)
T_1. Vermiwash from 100% cow dung	24.67	6.00	35.88
T_2. Vermiwash from 100% buffalo dung	23.00	5.67	34.93
T_3. Vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste	23.33	5.73	35.23
T_4. Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste	22.33	5.61	34.34
T_5. Vermiwash from 90% green waste incubated with 10% cow dung	22.00	5.33	34.11
T_6. Vermiwash from 90% green waste incubated with 10% buffalo dung	21.67	5.24	33.75
T_7. Vermiwash from 90% dry waste incubated with 10% cow dung	21.67	5.11	33.23
T_8. Vermiwash from 90% dry waste incubated with 10% buffalo dung	21.33	5.00	32.83
T_9. Water spray (Control)	19.00	4.60	32.24
S.Em±	0.64	0.24	0.071
CD(P= 0.05)	1.93	0.72	2.1

Table 3: Effect of vermiwash from different organic sources on yield and economics of blackgram.

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	B C ratio
$T_{1.}$ Vermiwash from 100% cow dung	800	1743	2.33
$T_{2.}$ Vermiwash from 100% buffalo dung	784	1704	2.26
$T_{3.}$ Vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste	786	1712	2.25
$T_{4.}$ Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste	765	1663	2.16
$T_{5.}$ Vermiwash from 90% green waste incubated with 10% cow dung	699	1521	1.87
$T_{6.}$ Vermiwash from 90% green waste incubated with 10% buffalo dung	691	1506	1.84
$T_{7.}$ Vermiwash from 90% dry waste incubated with 10% cow dung	685	1492	1.81
$T_{8.}$ Vermiwash from 90% dry waste incubated with 10% buffalo dung	676	1472	1.78
$T_{9.}$ Water spray (Control)	524	1168	1.33
S.Em±	31.96	69.65	0.09
CD(P= 0.05)	95.82	208.82	0.26

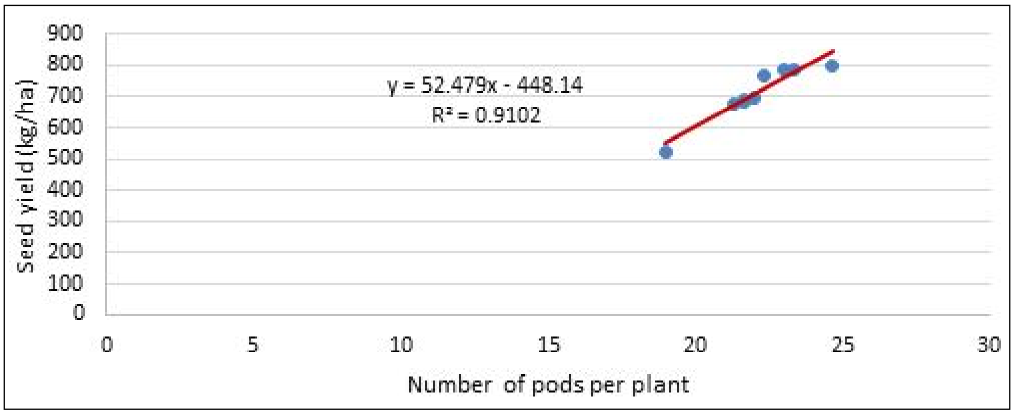

Fig 2: Correlation between number of pods $plant^{-1}$ and seed yield (kg ha^{-1}).

under different vermiwash treatments (Table 2). Among the different treatments, application of vermiwash from 100% cow dung registered higher number of pods $plant^{-1}$(24.67), seeds pod^{-1}(6) and test weight (35.88) which found to be at par with vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste, vermiwash from 100% buffalo dung, vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste. The positive impact of availability of plant nutrients, enzymes and growth hormones in balanced form might have induced cell division, cell wall expansion, high meristematic activity, photosynthetic efficiency and assimilate partitioning from source to sink that increased yield attributes and help to produce healthy seed. The result was in agreement with the findings of Jadhav *et al.* (2014). Among the treatments, the application of vermiwash from 100% cow dung significantly registered higher seed yield (800 kg ha^{-1}) and haulm yield(1743 kg ha^{-1})of blackgram on rest of treatments (Table 3). However, it was at par with vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste, vermiwash from 100% buffalo dung and vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste of blackgram, respectively. Crop yield is the complex function of physiological processes and biochemical activities which modify plant anatomy and morphology of the growing plants. This might be due to favourable effect of vermiwash on vegetative and reproductive growth *viz*., pods $plant^{-1}$, seeds pod^{-1} and test weight, which were the important yield attributes having significant positive correlation with seed and haulm yield (Fig 2). The similar results were also reported by Venkataramana *el at.* (2007); Hatti *et al.* (2010); Ramesh *et al.* (2012); Sundarasu *et al.* (2014); Bhardwaj and Sharma (2016) and Devasinghe and Kularathna (2016). It is evident from the results that the vermiwash prepared from different combination of organic sources considered in treatments had significant effect on growth and productivity of blackgram. Similar observation of vermiwash prepared from different vermicompost were reported by Rai and Bansiwal (2008); and Nath and Singh (2012).

Small and marginal farmers are more likely to consider a research result if it is economically viable. In the present study, the economics of blackgram cultivation was influenced by different vermiwash treatment (Table 3). The B:C ratio higher with the application of vermiwash from 100% cow dung (2.3) which was at par with the application of vermiwash from 100% buffalo dung, vermiwash from 50% cow dung +

25% dry farm waste + 25% green farm waste and vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste, respectively.

CONCLUSION

Considering the results of the experiment, it may be advocated that vermiwash prepared from different combination of organic sources have significant effect on growth and yield characteristics of blackgram under organic farming; and the treatment vermiwash from 100% cow dung (top dressing in two equal split application at the of 10% at initiation of flowering and 15 days after 1stspray) may be recommended as a better organic practice of blackgram followed by vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste, vermiwash from 100% buffalo dung and vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste, respectively.

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