PERFORMANCE OF INDIAN MUSTARD UNDER THE FERTILITY LEVELS AND COW URINE APPLICATION AS BASAL AND FOLIAR SPRAY IN EASTERN REGION OF UTTAR PRADESH

Abstract

The experiment was laid out in split plot design assigning 18 treatment combinations of two fertility levels (75% and 100% RDF), three cow urine level (400,800,1200 l ha^{-1}) as main plot and three spray level of cow urine (control, 25%, 50%) as sub plot with three replications. It was conducted at Varanasi during *rabi* season 2014 to evaluate the effect of fertility levels and cow urine application as basal and foliar spray on growth and yield of Indian mustard. Results showed that increasing level of fertility up to 100% RDF significantly improved growth parameters, yield attributes, grain and straw yield. Among the cow urine levels, treatment 1200 l ha^{-1} cow urine and 50% spray level of cow urine application proved superiority over other treatments, recorded significantly the highest, growth parameter, yield attributes, yield, gross returns, and net returns and B: C ratio.

***Key words**:* Cow urine**,** Economics, Fertility level, Growth, Indian mustard, Yield

Introduction

Indian agriculture should be more knowledge-intensive to keep pace with the rising population pressure and decreasing land and energy resources. Presently, rapeseed-mustard is the most ,important group of oilseed crops after groundnut and soybean in India, occupying 6.85 Mha

acreage, 9.12 Mt production and 1331 kg/ ha productivity (Ministry of Agriculture and Farmers Welfare, 2020). This crop accounts for about one-third of the vegetable oil produced in the country, making it the country's key edible oilseed crop. However, because of the enormous gap between domestic availability and actual consumption of edible oils, India has to depend on import of edible oils. Rapeseed-mustard is grown predominantly in *rabi* season under energy starved condition in marginal lands and rainfed conditions. Nutrient management is one of the important constraints for mustard productivity. Nutrient supplied exclusively through inorganic sources though increased yield initially, but the sustainability was not maintained over the years. Intensive land use with imbalanced use of inorganic fertilizers without the addition of organic manures significantly influences soil health and crop growth. Under such situations, it is important to integrate the various sources of organic nutrients Furthermore, their synergistic effect with chemical fertilizers for providing balanced nutrition and their use efficiency for long-term soil fertility, maintenance, productivity, and sustainability of agriculture is important for improvement in soil health and environmental safety.

Crop- livestock is the predominant farming system of India practiced over 70% of farm households. Cow urine, which usually drains out as uncontrolled as waste material and contributes to pollution, has a good manurial value and can be utilized as a biofertilizer. [1]. Cattle urine is an excellent source good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate [2]. Further, organic nutrient spray viz. cow urine at the critical growth stage of the crop, helps to overcome the problem of the slow release nutrients of organic sources affecting crop growth. Application of cow urine besides improving the soil texture and working as a plant hormone also been reported to correct the micronutrient deficiency, being organic in nature it also likely increase the fertilizer use efficiency [1]. Therefore, it seems that

cow urine under livestock based integrated farming system has a great potential for use as a bio fertilizer in crop production, both as soil application and foliar spray, and it needs to studied on mustard under existing climatic condition. With these facts in view, a field trial was conducted to explore the possibility of economizing fertilizer use in mustard by partial replacement of fertilizer through cow urine as bio-fertilizer.

Method and Material

A field experiment was conducted during the winter *(rabi)* season of 2014-15 at the Agricultural Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (UP). The experimental soil was sandy clay loam with poor in organic carbon (0.38%) and slightly alkaline in reaction (pH 7.7). The available N, P_2O_5 and K_2O were 190.5, 18.5 and 180.3 kg/ha, respectively. The available N, P, K, S Ca and Mg content in cow urine used in the experiment were 0.976%, 0.09%, 1.1%, 0.08% 0.01% and 0.1%, respectively. The experiment was laid out in split plot design. The main plot treatment involved a combination of two fertility levels i.e.75% and 100% Recommended fertilizers dose (120kg N+ 60 kgP_2O_5+ 60kg K_2O/ha) and three levels of cow urine as basal application i.e. 400, 800, 1200 l ha^{-1}. The sub plot treatment comprised of three levels of cow urine as foliar spray (0%, 25% and 50%) applied @ 600 l ha^{-1}at 30, 50 and 70 DAS. So, the total numbers of treatment combinations were eighteen which, were replicated thrice. Fertilizer application to the test crop was done as per treatment through urea, DAP, MOP and elemental sulphur respectively. Half dose of nitrogen, full doses of phosphorus, potassium and sulphur as per treatment were applied in furrows as basal dose. The rest dose of nitrogen was top dressed through urea at 30 day's stage after first irrigation as per the treatment. Basal application of cow urine was done as per treatment, with or without water, just before sowing in furrows through rose can. However, foliar application of cow urine was given as per the treatment at 30, 50 and 70

DAS. Mustard crop variety 'Kalasona' was used@ 5.0 kg seed/ha at a row distance of 40 cm. The sowing was done in furrrows, opened with the help of *kudal* and covered after sowing. Thinning of plants was done after 18 days of sowing in order to keep only one robust and healthy plant at a distance of 15 cm to maintain plant geometry at a spacing of 40 × 15 cm. Chemical weed control was done by application of Pendimethalin 30EC@1 kg ha^{-1} as per pre emergence spray which was accompanied by one mechanical-cum-manual weeding at 4 week stage of the crop. One pre sown and one post sowing irrigation were applied to maintain optimum soil moisture for plant growth.

Result and Discussion

Effect of fertility levels

The growth parameters viz. plant height, shoot dry weight, and leaf area index (LAI) were improved significantly by fertilizer applied at 100% RDF than 75% RDF (Table 1). Maximum chlorophyll content in terms of SPAD value at higher fertility level proved significantly superior to 75% RDF. Nutrient supply, favorably influenced the growth attributes, supporting its well-established role in proper growth and development. As a result, plant height and production of branches and leaves also increased, that resulted in higher shoot dry weight. [3, 4 and 5] also noticed a similar trend.

Treatment showed marked influence on Yield attribute. Application of fertilizer at 100% RDF recorded significantly higher number of siliqua $plant^{-1}$, siliqua length, seeds $siliqua^{-1}$ and maximum test weight, over 75% RDF. Favorable effect of the application of 100% RDF on growth and yield contributing factors was reflected in need and stover yield. Application of 100 % RDF produced 15.1 and 18.2% higher seed and stover yield, respectively over 75 % RDF. Under higher fertility levels more efficient mobilization of photosynthates to reproductive attributes is bound to occur which leads to resulted in bigger siliqua and more numbers of seed

which on maturity becomes bold with higher test weight. These results are found similar with the findings of Bohra *et al*. (1999); and Paliwal and Singh (2014). Application of 75% RDF recorded significantly higher harvest index as compared to 100% RDF. This shows that 75% RDF utilized the applied nutrients at higher level of efficiency towards the seed than stover yield. These results are in conformity with the finding of Ghimire and Bana (2011) and Verma *et al.* (2018).

Effect of soil application of cow urine

Increasing levels of application of cow urine from 400 to 1200 l ha^{-1}markedly influenced growth characters like plant height, leaf area index and shoot dry weight $plant^{-1}$. However, the variations were more pronounced between 400 and 1200 l ha^{-1}urine application. This may be due to the higher content N in cow urine which might have favoured protein synthesis and so leads to higher photosynthesis, K, the other major constituent of cow urine (0.11 ppm) as an enzymes activator regulates carbohydrate metabolism and protein synthesis and eventually the growth. Leaf chlorophyll content through increased with increasing levels of cow urine application, the differences failed to touch the level of significance.

Cow urine applied as basal application enhanced improved the yield attributing characters to mustard. It was noted that increase in urine levels from 400 to 1200 l ha^{-1} correspondingly enhanced the number of siliqua $plant^{-1}$, seeds $siliqua^{-1}$, 1000 seed weight and seed yield $plant^{-1}$ (Table 1). Nitrogen is one of the essential constituents of cow urine, which has been reported to enhance the process of tissue differentiation, cell multiplication, cell growth *i.e*. from somatic to reproductive phase, meristematic activity and improvement of floral primodia leading thereby to increased flowering and finally the fruit setting. However, the harvest index and siliqua length could not confirm variable response to urine application. The findings are conformity with the findings of Vahanka *et al*. (2010); Singh *et al*. (2014); Pradhan *et al.* (2016).

Marked effect of soil application of cow urine were observed on need and stover yield. However, the difference between 400 and 800 l ha^{-1}did not turning significant both for need and stover yield. Higher urine levels produced taller plants and increased number of functional leaf $plant^{-1}$, accumulation of dry matter $plant^{-1}$, siliqua $plant^{-1}$, seeds $siliqua^{-1}$, and 1000 seed weight which ultimately resulted in higher grain and stover yield. The results are in agreement with the findings of Mohanty *et al.* (2014), Oliveira *et al.* (2009), Singh *et al*. (2014).

Effect of foliar spray of cow urine

In present investigation, lucid effect of foliar application of cow urine were observed on growth attributing characters of mustard viz. plant height, chlorophyll content (SPAD), LAI, dry weight of shoot $plant^{-1}$ at all the stages of crop growth during the experimentation. The effect of urine application as foliar spray on growth attributing characters was significant mostly between 50% urine spray and control at all the growth stages. Urine spray has been found to bring rapid changes in phenotypes of plants and also improve the growth and productivity. The biochemical contents viz. carbohydrates, protein, and amino acids found in plants sprayed with cow urine were more irrespective of the concentration which leads to enhance growth attributes, from 400 to 1200 l ha^{-1}probably because of better supply of nitrogen at higher rates of urine application.

Urine applied as foliar spray also enhanced the yield contributing characters *viz*. siliquae on main shoot, siliqua $plant^{-1}$, seeds $siliqua^{-1}$, siliqua length, 1000 seed weight and seed yield $plant^{-1}$ (Table 1). The significant improvement in dry matter accumulation, chlorophyll content and nitrogen content described above may be ascribed to better yield attributes under 50% cow urine spray. Foliar spray of cow urine at a rate of 50% recorded significantly the highest seed yield and stover yield as compared to control. The increase in seed and stover yield at higher concentration of cow urine produced taller plants and increased number of functional leaf $plant^{-1}$, accumulation

of dry matter plant^{-1}, siliqua plant^{-1}, seeds siliqua^{-1}, and 1000 seed weight which ultimately resulted into higher grain and stover yield. The results are similar with the research findings of Verma *et al.* (2018), Mohanty *et al*. (2014), Oliveira *et al.* (2009), Singh *et al*. (2014).

Comparative economics

The differences in gross return under various fertility and urine levels as basal as well as foliar spray were mainly due to the differences in seed and stover yield. Whereas, the cost of cultivation varied due to different quantities of fertilizer and urine applied. The Gross and net return were significantly higher at higher fertility level. Benefit: cost ratio also followed the similar trend. This shows that 100% RDF was more remunerative over the lower level of fertility (75% RDF). Gross return was increased with increasing levels of soil urine application from 400 to 1200 l ha^{-1}. Nevertheless, for net return the difference was significant only between 400 and 1200 l ha^{-1}. This shows that application of cow urine is remunerative at 1200 l ha^{-1}. Similar trend was noticed for B: C ratio indicating that basal application of cow urine even at the highest rate of application was utilized efficiently. Foliar application of cow urine at 50% concentration enhanced the gross and net return over control indicating that foliar application of cow urine at 50% was remunerative. The results are in agreement with the findings of Verma *et al.* (2018), Mohanty *et al.* (2014), Oliveira *et al.* (2009), Singh *et al*. (2014).

Conclusion

Nutrient supplied exclusively through inorganic sources though increased yield initially, but the sustainability was not maintained over the years. Intensive land use with imbalanced use of inorganic fertilizers without the addition of organic manures significantly influences soil health and crop growth.

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Table-1. Effect of fertility levels and cow urine application as basal and foliar spray on growth and growth contributing characters of mustard

Treatment	Plant height	Shoot dry weight/plant(g)	LAI(70 DAS)	Chlophyll (70 DAS)	Siliquaeplant^{-1}	Siliqua length (cm)	Seeds siliqua^{-1}	1000-seed weight(g)
Fertility levels								
75% RDF	165	18.6	3.05	37.5	129	4.90	12.6	4.50
100% RDF	169	22.0	3.23	39.3	138	5.04	13.3	4.73
S. Em±	**1.4**	**0.69**	**0.03**	**0.4**	**2.1**	**0.04**	**0.16**	**0.06**
C.D. 5%	**4.4**	**2.18**	**0.09**	**1.3**	**6.5**	**0.12**	**0.51**	**0.17**
Urine levels (l ha^{-1})								
400	163	18.3	3.02	37.8	127	4.92	12.3	4.46
800	167	20.6	3.16	38.4	132	4.96	13.0	4.69
1200	169	22.0	3.24	39.1	142	5.03	13.5	4.69
S. Em±	**1.7**	**0.85**	**0.03**	**0.5**	**2.5**	**0.05**	**0.20**	**0.07**
C.D. 5%	**5.4**	**2.67**	**0.11**	**NS**	**8.0**	**NS**	**0.62**	**0.21**
Urine spray								
Control	164	18.8	3.07	37.7	129	4.91	12.2	4.52
25%	166	20.2	3.13	38.4	132	4.97	13.1	4.55
50%	170	22.0	3.22	39.3	140	5.04	13.6	4.78
S. Em±	**0.8**	**0.66**	**0.03**	**0.4**	**1.6**	**0.04**	**0.25**	**0.07**

C.D. 5%	**2.4**	**1.91**	**0.09**	**1.3**	**4.6**	**0.11**	**0.72**	**0.20**

Table-2 Effect of fertility levels and cow urine application as basal and foliar spray on yield and economics of mustard.

Treatment	**Seed yield (kg ha^{-1})**	**Stover yield (kg ha^{-1})**	**H.I. (%)**	**Gross Return (Rs. ha^{-1})**	**Cost of Cultivation (Rs. ha^{-1})**	**Net return (Rs. ha^{-1})**	**B:C ratio**
Fertility levels							
75% RDF	1129	3627	23.7	48080	31566	16514	1.52
100% RDF	1299	4286	23.3	55385	33382	22004	1.66
S. Em±	**24.5**	**77.8**	**0.07**	**1040**	**-**	**1040**	**0.03**
C.D. 5%	**77.1**	**245.1**	**0.23**	**3277**	**-**	**3277**	**0.10**
Urine levels (l ha^{-1})							
400	1132	3717	23.4	48273	31827	16446	1.51
800	1205	3918	23.5	51354	32483	18870	1.58
1200	1305	4235	23.6	55572	33111	22461	1.68
S. Em±	**30.0**	**95.3**	**0.09**	**1274**	**-**	**1274**	**0.04**
C.D. 5%	**94.4**	**300.2**	**NS**	**4013**	**-**	**4013**	**0.12**
Urine spray							
Control	1189	3862	23.6	50636	31987	18648	1.58
25%	1204	3938	23.4	51306	32483	18823	1.58
50%	1250	4070	23.5	53256	32950	20306	1.61
S. Em±	**12.7**	**40.2**	**0.11**	**536**	**-**	**536**	**0.02**
C.D. 5%	**37.2**	**117.4**	**NS**	**1565**	**-**	**1565**	**NS**