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Effect of organic farming system (solid and liquid organic manures) on growth, productivity and quality of soybean (*Glycine Max* L. Merrill)

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Abstract: Field experiment was carried out during the *kharif* season of 2012-13 to evaluate the effect of different solid and liquid forms of organic manure on growth and yield of soybean. The treatment consisted of three sources of solid (Vermicompost 2.6 t ha^{-1}, Farmyard manure 16 t ha^{-1} and Poultry manure 2.2 t ha^{-1}) and liquid (*Panchgavya* and Fish Amino Acid) forms of organic manures and two cultivars (JS 335 and JS 95-60). The experimental results revealed that FYM + *Panchgavya* + Variety JS 335 recorded at all stages (growth stages plant height (55.33 cm) number of branches plant^{-1}(12.13) and dry weight g plant^{-1} (12.00), there were significant difference between treatments. The maximum biological yield (6191.66 kg ha^{-1}), net return (72925.66 Rs. ha^{-1}) and B :C ratio (2.66) observed in treatment T_{10}(Farmyard manure + *Panchgavya* + Variety JS 335), but highest oil content (20.00%) and chlorophyll content (49.53%) observed in treatment T_2 (Vermicompost + *Panchgavya* + Variety JS 335) and protein content(38.49%) observed in T_6 (Poultry manure + *Panchgavya* + Variety JS 335).

Key words: Organic farming, Farm yard manure, Vermicompost, *Panchgavya*, Variety JS 335

Introduction

Soybean (*Glycine max* L.) is considered as a wonder crop of 21st century which is the top oil seeds in the world production. Imkongtoshi and Gohain (2009). It contains 18 to 22% oil, highly desirable in diet and has 40 to 42% of good quality protein. Therefore, it is the best source of protein and oil and truly calcium the title of the meat/oil on plants. Generally, it is used in the food industry for flour, oil, cookies, candy, milk, vegetable cheese, lecithin and many other products (Fatima *et al.,* 2006).. The major constraint affecting the productivity is the adequate availability of suitable genotype and nutrients (Venkateswarlu *et al*., 1987). Choosing and cultivation of suitable genotype that adapts itself under the peculiar climatic condition of the Allahabad region is a necessity for soybean sustainability. Concomitantly, adoption of appropriate agronomic operations may result in acceptable phenotypical characteristics, *viz*., plant height number of branches plant^{-1} dry matter production, nodulation and ultimate enhancement of productivity of the crop. One of the feasible solutions for addressing the imbalanced nutrient and related constrains, is the foliar spray of *Panchgavya*, which promote growth and vigour of plant and improves productivity (Natarajan, 2002), Pathak and Ram, 2002). The management of manures within a crop rotation can have large effects on yields and crop quality (Stein-Bachinger and Werner, 1997). Organic farming plays greater role in maintaining soil health and reducing the risk of soil erosion when compared to chemical farming (Reganold and Palmer, 1995). Soybean grown both as an oil seed and grain legume, fixes atmospheric nitrogen in soil and makes it available to partially fulfill the nitrogen requirement of succeeding crop (Jaybhay *et al.,* 2015). There is need to refining and standardized package of practice for important crop under organic farming system. Nutrient imbalance is one of the important constraints of soybean productivity and quality. Therefore in the present investigation effect of various of solid and liquid organic manure on (farmyard manure, Vermicompost, poultry manure, *Panchgavya* and Fish amino acid) growth and yield of soybean was carried out.

Materials and Methods

The soil of the experimental field was shallow in depth (30 cm) having 0.34% organic carbon, 13.50 kg ha^{-1} available P_2O_5, 257.00 kg ha^{-1} available K_2O, pH 7.5 and EC (0.13 dS m^{-1}). The experiment was carried out at the Crop Research Farm, Department of Agronomy (SHIATS Model Organic Farm, Block-E) Allahabad School of Agriculture, Allahabad, in Randomized Block Design with three replication. The treatment combinations in the experiment comprised of 3 sources of solid organic manures *viz*., Farmyard manure, Poultry manure and Vermicompost which were calculated on the basis of 40 kg ha^{-1} phosphorus equivalency (Farmyard manure 16 t ha^{-1}, Poultry manure 2.2 t ha^{-1} and Vermicompost 2.6 t ha^{-1}), 2 cultivars (JS 335, JS 95-60), and 2 sources of liquid manures (*Panchgavya* 3% and Fish amino acid 3%). These sources of foliar application were applied during grand growth (30 DAS), branching (45 DAS) and flowering (60 DAS). *Panchgavya* was prepared with a mixture of five components

in the ratio of 5:4:3:2:1, *viz.,* cow dung, cow urine, milk, curd, cow ghee and six ripe bananas respectively, which was fermented for 21 days. Use of 3% Panchgavya solution in field. Prepare 3% solution by 300 ml Panchgavya added with 10 liter water. 300 liter water require of one hectare. Three spray application in crop duration time, then one hectare require nine liter Panchgavya. Fish amino acid was prepared with a mixture of two components in the ratio of 1:1, *viz.,* fish waste and jaggery which was fermented for 21 days. Chlorophyll content was measured by SPDA 502 handheld chlorophyll meter and the data was recorded in per cent. Measurements were taken Minolta SPDA Opti-Sciences CCM chlorophyll meter on leaves of a soybean crop. Plastic filter were used as leaf models because of their similarity to leaf spectra and their uniformity of colour (Richardson *et al*., 2002). Oil content in kernels was estimated through 'Soxhlet's apparatus using petroleum ether as organic solvent (40-60 ^{0}C) as per the methodology of Perry and Green, 1988.

Oil content in kernels (%) = $(W_2 - W_1) / W_3 \times 100$

Where: W_1= Wt. of flask (g); W_2= Wt. of flask+oil (g); W_3= Wt. of sample (g)

One g material was taken and it was homogenized with 10 ml buffer solution, after that the content was filtered and finally 10 ml filterate was taken and it was mixed with 10 ml 10% TCA, after that it was kept for half an hour and then filtered. The residue was dissolved in 5 ml 0.1% N NaOH. Further, 1 ml filtrate was taken and 5 ml alkaline copper reagent was added. Solution was mixed well by centrifuge at 5000 rpm and kept for 10 minutes at room temperature. Half ml folin reagent was added and kept for 30 minutes. Finally the intensity was recorded at 660 nm (Lowry *et al*., 1951)**.** It was calculated by the formula:

Protein (%)= (100×OD×total volumes made up×100)/ 0.12×W×10

Where: OD = optical density, W = weight of sample

1. TCA Solution (10%): 10 g TCA was dissolved in 100 ml water
2. 0.1 N NaOH NEV = (0.1 × 40 × 100) / 1000 **=** 0.4
   (0.4 g was dissolved in 100 ml of distilled water)
3. Alkaline copper reagent: 50 ml reagent (i) and 2 ml reagent (ii)
   (i) 4% sodium carbonate in 0.1% N NaOH;
   (ii) 0.5% $CuSO_4$ in 1% sodium potassium tartarate
4. Folin reagent 1:1 ratio with distilled water

Pooled analysis of the data for four years was carried out using standard analysis of variance suggested by Gomez and Gomez (1984).

Variety and agronomic practices: Soybean variety JS-335 is a medium duration, high yielding variety, widely cultivated in India. The crop was sown in the first week of July and harvested at last week of October in all the experimental years at 30 cm row spacing and 10 cm. between plants. Hand weeding was done once at 35 days after sowing.

Results and Discussion

There was progressive increase plant height, number of branches plant^{-1} at 75 DAS, number of nodules plant^{-1} at 60 DAS and dry weight at 45 DAS significantly higher values (55.33, 12.13, 30.33 and 12.00 g respectively) observed in treatment T_{10} (Farmyard manure + *Panchgavya* + Variety JS 335), but chlorophyll content significantly higher values (49.53%) observed in treatment T_2 (Vermicompost + *Panchgavya* + Variety JS 335). However, plant height, number of branches plant^{-1} and number of nodules plant^{-1} in treatment T_2 (Vermicompost + *Panchgavya* + Variety JS 335), were found to be statistically at par with T_{10} (Farmyard manure + *Panchgavya* + Variety JS 335). Further plant height, dry weight and chlorophyll content in treatment T_1 (Vermicompost + Fish Amino Acid + Variety JS 335) and number of branches, number of nodules and chlorophyll content in treatment T_9 (Farmyard manure + Fish amino acid + Variety JS 335), were found to be statistically at par with T_{10} (Farmyard manure + *Panchgavya* + Variety JS 335).

Organic manure is most beneficial which effectively enhance growth of soyabean by improving the physical, chemical and biological properties of the soil. Application of organic manures such as Farmyard manure increases the availability of macro and micro nutrient, and promotes the activity of beneficial micro-organism under the organic farming system (Chaturvedi *et al*., 2010. Increased plant height in the present investigation might be due to optimum nutrient uptake and reduced loss of N, *etc*, which was evident in treatments with vermicompost application. Similar findings were reported by Grapelli *et al*. (1985). Further, organic manures may have stimulated the functional activities of cells in roots of the plants (Rahman *et al*., 2012). The application of organic manures decrease bulk density, improve the soil environment including physico-chemical (such as enhanced nitrogenase activity), biological condition, aeration and micro climate of photosphere resulting in maximum penetration of rhizobium in root hairs (Mishra *et al*., 1990 and Yawalkar *et al*., 1996). Additionally the significantly increased number of nodules plant^{-1} might have been due to the ready availability of nutrients like phosphorus, through liquid organic formulations, *i.e*., *Panchgavya* as foliar spray at critical stages, which would have triggered nodulation. Similar findings were reported by Ahlawat and Omprakash (1996)

The maximum oil content (20.00%) recorded in treatment T_1 (Vermicompost + Fish Amino Acid + Variety JS 335) and protein content (38.49%) observed in treatment T_6 (Poultry manure + *Panchgavya* + Variety JS 335). Further biological yield, net return and B: C ratio (6191.66 kg ha^{-1}, ₹72925.66 ha^{-1} and 2.66 respectively) were recorded in T_{10} (Farmyard manure + *Panchgavya* + Variety JS 335). The data of economics revealed that foliar application of *Panchgavya*, farm yard manure along with Variety JS 335 increased net returns and B: C ratio compared to other organic manure, being highest net return and B: C ratio. The optimum dose of nutrient through organic sources, which play an important role in increasing the output of soybean crop and sustain the fertility and productivity of the soil (Behera *et al*., 2007) has shown itself to be economically promising. Application of FYM and vermicompost produced maximum oil content. It may be due to higher rate of availability of sulphur from FYM and vermicompost (Behra, 2002). Vermicompost is most beneficial which effectively enhance growth of soybean by improving the physical, chemical and biological properties of soil (Sheikh *et al.,* 2015). The protein synthesis increased in seed due to elevated contribution of nitrogen through organic manures that finally lead to increased protein content. Similar findings were reported by Evans and Sarger (1996). The better performance of organic manures (Farmyard manure, *Panchgavya*, etc) might be associated with sustained nutrient supply, increased root nodulation, which amplified the photosynthetic activity (Pakhale *et al*., 2009) and good translocation efficiency (Tandaie *et al*., 2009).

Table-1: Effect of solid and liquid forms of organic manures on growth of two cultivars of soybean

Treatments			75 DAS		60 DAS	45 DAS	70 DAS
			Plant ht. cm	Number of Branches plant^{-1}	Number of Nodules plant^{-1})	Dry wt. (g plant^{-1})	Chlorophyll content (%)
Vermicompost	Fish Amino Acid	Variety JS 335	49.53	10.00	21.33	11.33	48.09
Vermicompost	*Panchgavya*	Variety JS 335	51.80	10.66	29.33	7.33	49.53
Vermicompost	Fish Amino Acid	Variety JS 95-60	34.60	6.60	10.66	8.33	28.83
Vermicompost	*Panchgavya*	Variety JS 95-60	36.93	7.06	16.33	8.33	39.00
Poultry manure	Fish Amino Acid	Variety JS 335	46.80	10.00	20.66	7.00	42.57
Poultry manure	*Panchgavya*	Variety JS 335	45.53	10.40	22.33	8.00	42.55
Poultry manure	Fish Amino Acid	Variety JS 95-60	37.86	7.33	17.33	6.33	36.69
Poultry manure	*Panchgavya*	Variety JS 95-60	38.73	7.00	16.33	8.00	39.71
Farmyard manure	Fish Amino Acid	Variety JS 335	47.00	11.06	26.66	8.66	44.82
Farmyard manure	*Panchgavya*	Variety JS 335	55.33	12.13	30.33	12.00	49.28
Farmyard manure	Fish Amino Acid	Variety JS 95-60	36.47	7.66	19.66	8.66	34.06
Farmyard manure	*Panchgavya*	Variety JS 95-60	36.86	6.66	16.33	7.33	28.63
SEd (±)			3.77	0.86	3.43	0.91	9.42
CD (P= 0.05)			7.81	1.78	7.11	1.90	8.67
CV (%)			10.70	11.84	20.37	13.27	12.69

Table-2: Effect of solid and liquid forms of organic manures on quality, yield and economics of two cultivars of soybean

	Treatments			*Oil content (%)	*Protein content (%)	Biological yield (kg ha^{-1})	*Net return (Rs. ha^{-1})	*B:C ratio
T_1	Vermicompost	Fish Amino Acid	Variety JS 335	20.00	37.32	3819.00	36840.35	1.94
T_2	Vermicompost	*Panchgavya*	Variety JS 335	18.00	37.54	4918.33	45732.35	2.17
T_3	Vermicompost	Fish Amino Acid	Variety JS 95-60	17.33	36.82	3182.66	16263.66	1.41
T_4	Vermicompost	*Panchgavya*	Variety JS 95-60	18.33	37.33	3414.00	22239.00	1.57
T_5	Poultry manure	Fish Amino Acid	Variety JS 335	18.66	38.28	4803.00	51869.66	2.34
T_6	Poultry manure	*Panchgavya*	Variety JS 335	17.66	38.49	3992.33	52013.66	2.35
T_7	Poultry manure	Fish Amino Acid	Variety JS 95-60	17.33	37.65	3529.66	34209.66	1.88
T_8	Poultry manure	*Panchgavya*	Variety JS 95-60	18.66	37.92	3993.00	57685.00	2.49
T_9	Farmyard manure	Fish Amino Acid	Variety JS 335	17.66	37.41	4574.66	49450.35	2.12
T_{10}	Farmyard manure	*Panchgavya*	Variety JS 335	19.33	37.53	6191.66	72925.66	2.66
T_{11}	Farmyard manure	Fish Amino Acid	Variety JS 95-60	18.66	36.93	3703.33	25057.00	1.55
T_{12}	Farmyard manure	*Panchgavya*	Variety JS 95-60	18.33	37.23	3934.66	34849.00	1.79
	SEd (±)			-	-	728.95	-	-
	CD (P= 0.05)			-	-	NS	-	-
	CV (%)			-	-	21.40	-	-

In Table 1 and 2: VC: Vermicompost (2.6 t ha^{-1}), FYM: Farmyard manure (16 t ha^{-1}), FAM: Fish Amino Acid (3%), PM: Poultry manure (2.2 t ha^{-1}), Panchgavya (3%), *Data was not subjected to statistical analysis

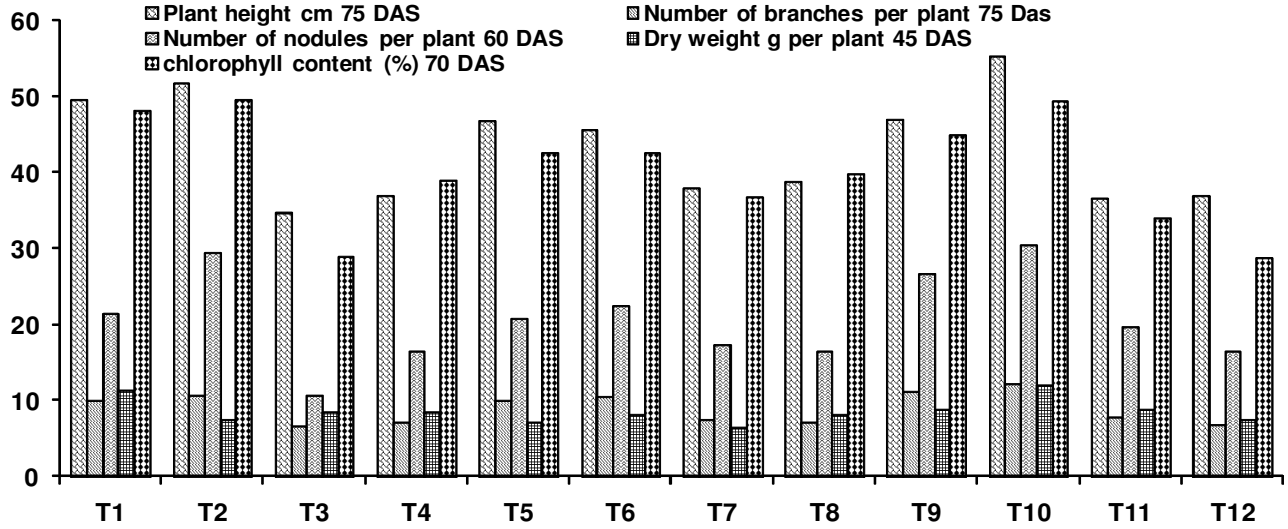

Fig. 1: Effect of solid and liquid forms of organic manures on growth of two cultivars of soybean

One liter *Panchgavya* cost of 63.25. One hectare require nine liter Panchgavya, nine liter cost of *Panchgavya* 1707. *Panchgavya* spray requires one labour for one hectare, then three sprays of *Panchgavya* three labour needs. One labour charge 165, then three spray labour charge 495. Total charge spray of *Panchgavya* 2202. It is possible to apply to in field for low cost spray of *Panchgavya* under organic farming. The usage of fermented organic formulations with supportive beneficial microorganisms as foliar nourishment has been come into the picture of modern agriculture for giving rise to good quality non residue protected food (Galindo *et al*., 2007). Consequences of *Panchgavya* application are superior growth, yield and quality of crops. This liquid organic solution is prepared from cow dung, urine, milk, curd, ghee, six ripe bananas. It provides macro nutrients, essential micro nutrients, many vitamins, required amino acids, growth promoting substances and beneficial microorganisms for plants well growth (T. Sivakumar, 2014).

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