J. Soils and Crops 31 (1) 1-6, June 2021

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFECT OF ORGANIC AND CHEMICAL FERTILIZERS ON GROWTH, YIELD AND YIELD COMPONENTS OF SOYBEAN (*Glycine max* L.) IN WESTERN ETHIOPIA

Fayera Asefa[1] and Alemayehu Wagari[2]

ABSTRACT

Soybean (*Glycine max* L.) is well adapted to midland and highland soils of the Ethiopia. Due to the declining of soil fertility by numerous side effects of chemical fertilizers, use of organic fertilizers is an alternative way for the enhancement of crop production and maintenance of soil fertility. Yields are very low in average about 1500 kg ha^{-1} even if applying the tentative recommended dose of fertilizers in the country. The experiment was conducted starting from 2019 by using irrigation water at Jamma Geneti district, Oromia, western Ethiopia. The objective of the study was to investigating the effects of farmyard manure, vermicompost and blended NPS fertilizer on the growth, yield and yield components of soybean varieties. The healthy and improved soybean varieties (Boshe at a rate of 95 kg ha^{-1} and Dhidhessa at a rate of 90 kg ha^{-1}) were used as a test crops. A total sixteen different treatments of farmyard manure, vermicompost and blended NPS fertilizers were used and laid out in randomized complete block design (RCBD) with three replications. The results revealed that there were significant differences in crop phenology, growth, yield and yield components. In these parameters, the maximum days to flowering, and days to maturity were obtained from application of 100 kg NPS ha^{-1} (TRDF) with Dhidhessa variety, whereas the highest plant height, leaf number, productive branch, pods number and biomass yield (5102.30 kg ha^{-1}) were recorded by the application of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} with Dhidhessa variety. Also, the highest number of nodules and seeds in pod, hundred seeds weight, the highest grain yield (2536.50 kg ha^{-1}) were recorded by the application of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} with Boshe variety. Therefore, taking the findings of the present study into consideration it may be concluded that at Jamma Geneti district using the combination of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} fertilizer is the promising choice than application of inorganic fertilizer alone to improve the grain yield of soybean Boshe variety.

(Key words: Vermicompost, blended NPS, farmyard manure, soybean varieties, grain yield)

INTRODUCTION

Soybean (*Glycine max* L.) is one of the world's most important legumes in terms of production and trade and has been a dominant oilseed since the 1960s (Albiach *et al*., 2000). It contains the highest protein, edible oils, carbohydrates, good amount of vitamins and energy among the legumes (Kaul and Das, 1986) and the crop is grown on an estimated 6% of the world's arable land, and since the 1970s (Hartman *et al*., 2011). In Ethiopia, soybean is a new crop, struggling to introduce in irrigated and rain-fed farming to increase human nutrition, and improve to soil fertility also (Ibriahim, 2011). Ethiopian conditions the average yield of soybean is less than 1500 kg ha^{-1}. Nevertheless the international yield of soybean is 2.8 ton ha^{-1}(Langemeier and Purdy, 2019). Its productivity is often limited may be due to the low availability of essential nutrients, using chemical fertilizer alone that led to imbalanced nutrition. The long-standing use of inorganic fertilizers without any organic fertilizers additions damages the physical, chemical and biological properties of soil and causes a pollution of soil and reduction of crop productivity (Moghadam *et al.,* 2014).

Harmful effects of chemical fertilizers have shifted the interests of researchers towards organic amendments like vermicompost and manures, which can increase the production of crops (Joshi *et al*., 2014).Vermicompost is the microbial composting of organic wastes through earthworm activity to form organic fertilizer which contains higher level of organic matter, organic carbon, macro and micronutrients,

1. Lecturer in Agronomy (M.Sc.), Dept. of Plant Sciences, Faculty of Agriculture, Wollega University, Ethiopia.Email: fayeraasefa@gmail.com
2. Lecturer in Agronomy (M.Sc.), Dept. of Plant Sciences, Faculty of Agriculture, Wollega University, Ethiopia

microbial and enzyme activities (Parthsarathi *et al*., 2007). Vermicompost increases the chlorophyll content, carbohydrate and protein content and improve the quality of the fruits and seeds (Moghadam *et al*., 2014). Also, farmyard manures act not only as a source of nutrients and organic matter, but also increase microbial biodiversity and activity in soil and many other changes related to physical, chemical and biological properties of the soil (Albiach, *et al*., 2000).

Although, chemical fertilizers are playing a crucial role to meet the nutrient requirement of the crop, persistent nutrient depletion is posing a greater threat to sustainable agriculture. So, the use of organic manure with combination of chemical fertilizers, helps in improving physical and chemical properties of the soil, improves the efficient utilization of applied fertilizers resulted in higher seed yield and quality (Moghadam *et al*., 2014). Likewise, Lourduraj (2000) has also described that the combined application of' inorganic and organic manures significantly enhanced the growth attributes and yield of soybean as compared to the sole application of either of them. Fertilization imbalance is one of the important factors affecting the productivity of soybean. Therefore, having the above facts in view, the present study investigated the effects of farmyard manure, vermicompost and blended NPS fertilizers on the growth, yield and yield components of soybean varieties.

MATERIALS AND METHODS

The experiment was conducted in Jimma Geneti district, Oromia, western Ethiopia on demonstration farm of the Wollega University starting from 2019 by using irrigation water. The area located at an altitude of 2560 m.a.s.l. with varying mean annual rainfall of 1900-2400 mm. The mean daily temperature ranges from 16 and 23°C. The soil type of the area is sandy clay loam. The experiment was laid out in a randomized complete block design (RCBD) with three replications, and the healthy and improved soybean varieties (Boshe at a rate of 95 kg ha^{-1} and Dhidhessa at a rate of 90 kg ha^{-1}) were used in the present study. Treatments were given to the soil before sowing of seeds in different concentrations as Farmyard manure (2.5 ton ha^{-1}), Vermicompost (2.5 ton ha^{-1}) and Blended NPS fertilizer (50 kg ha^{-1}, 75 kg ha^{-1}, 100 kg ha^{-1}). NPS blended (100 kg ha^{-1}). The ratio of blended NPS nutrient contain:-19:38:7 (N: P_2O_5: S) was used as tentatively recommended dose of fertilizer for the study area. The field was prepared by digging out about 20 - 30 cm of soil and soil sample had taken for analysis of physico-chemical properties of the soil. Before two week of the seeds sowed, the farmyard manure and vermicompost was mixed to the soil plots in keeping with the treatments assigned. The cow-dung and plant residues used as earthworm feed for vermicompost preparation, and Eisenia Fetida earthworm at a rate of 100 earthworms' m^{-2} used by ensuing all the preparation procedures. Experimental gross plot size was 5 rows of 2.5 m length and 2 m width each line of each plot and the experimental net plot size was 3 rows of 2.5 m length and 1.2 m width each line of each plot. The gross and net plot was 5 m^2 and 3 m^2, respectively, consisted of 25 harvestable plants from each line for net plot with different rows. The space between plots and blocks was 0.6 m and 1 m, respectively. The fertilizers were spaced at 10 cm between plants and 40 cm between rows and immediately irrigated.

The days to flowering was recorded as number of days from date of sowing to the time when 75% of the flowers initiation in each plot, whereas days to 90% physiological maturity was recorded when the plants showed yellowing of leaves and pods. The ten plants from each plot was randomly selected and tagged for measuring the plant height (cm), number of leaves and primary branches at the physiological maturity of the plant. For the total above ground dry biomass (kg) and number of pods $plant^{-1}$also ten randomly selected plants net $plot^{-1}$ were counted at the time of harvesting in kilogram and finally converted into $hectare^{-1}$.

The total number of seeds was threshed and counted, and determined as the average number of seeds pod^{-1} for each plot. Also, hundred seed weight (g) was determined from the harvested bulk of seeds net $plot^{-1}$ using a sensitive balance. Grain yield was measured after leaving the harvested plants in an open air for about 14 days to dry so that they attained constant weight and converted to $hectare^{-1}$ basis. Plus the harvest index was calculated as the ratio of grain yield to total above ground dry biomass yield.These collected data were statistically analyzed by ANOVA using SAS 9.4 version, statistical software [Anonymous, 2008]. The treatment means were separated using LSD at 5% level of probability.

RESULTS AND DISCUSSION

The analysis of variance showed significant differences ($P<0.05$) on days to flowering and maturity (Table 3). The 100 kg NPS ha^{-1} treatment took maximum days to flower (82.50) and physiological maturity (145) with Dhidhessa variety as compared to treatments (Table 3). The minimum value of days to flower (76.50) and physiological maturity (133) were recorded under unfertilized plot in the Boshe variety. This is might due to the low nutrients found in the soil. The maximum days to flowering and physiological maturity might be due to the maximum amount of nitrogen present in blended NPS fertilizer which applied without combined with organic fertilizer or the varietal characteristics of the soybean varieties which have different growing habit, flowering and physiological maturity days. Similarly, Habtamu *et al*. (2018) reported that application of N fertilizer significantly delayed flowering and physiological maturity of soybean. Soybean varieties had varietal characteristics to flowered and matured earlier than other varieties (Tadesse and Sentayehu, 2015 and Kibiru, 2018). Chandrashaker *et al.* (2014) also obtained similar result using organic and inorganic fertilizers in chickpea.

Table 1. Selected chemical, microbiological and physical properties of the soil of the study site before fertilizers applied

Variable	Units	Mean	Standard Deviation
Textural class	-	Sandy Clay Loam	-
Soil pH (1:2.5 H_2O)	pH meter	5.07	0.02
Organic Carbon	(%)	6	0.01
Total Nitrogen	(%)	0.653	0.001
Soil Organic Matter	(%)	3.44	0.02
Phosphorus	(ppm)	9.84	1.53
Cation Exchange Capacity	(meq/100g soil)	28.67	0.01
Available Sulfur	(meq/100g soil)	0.197	0.001

Table 2. Basic chemical properties of vermicompost and farmyard manure applied to the soil plots

Items	In Vermicompost	In Farmyard Manure	Items	In Vermicompost	In Farmyard Manure
In Farmyard Manure					
Soil pH (1:2.5 H_2O)	7.24	7.24	Available Potassium (meq/100g)	9.01	4
Organic Carbon (%)	9.3	5.92	Calcium (meq/100g)	31	22
Total Nitrogen (%)	2.3	1.1	Magnesium (meq/100g)	31	22
Organic Matter (%)	6.72	1.8	Electric Conductivity (meq/100g)	1.3	1.12
Total Phosphorus (%)	1.4	0.5	Cation Exchange Capacity (meq/100g)	29	17
Available Sulfur (ppm)	312	122			

The results of analysis of variance revealed that farmyard manure, vermicompost and blended NPS fertilizers had significant ($P<0.05$) effect on number of nodules of soybean varieties (Table 3). The highest number of nodules (20.00) was recorded at 75 kg NPS ha^{-1}+ 2.5 ton VC ha^{-1}in the Boshe variety (Table 3). The minimum number of nodules from Boshe variety (6.33) and from Dhidhessa variety (7.10) were recorded at unfertilized plots and both were not significantly different. The 75 kg NPS ha^{-1}+ 2.5 ton VC ha^{-1} fertilizer rate was increase the minimum number of nodules by 3.47% than all treatments. This increment might be due to high amount of nutrients applied through combined application of vermicompost and blended NPS fertilizer. Equally, Devi *et al*. (2013) also obtained similar result in soybean.

There were significant differences ($p<0.05$) among treatments and varieties due to application of rates and types of fertilizers (Table 3). The highest plant height (132.83 cm), number of leaves (68.92) and number of productive branches (5.72) were obtained from 75 kg NPS ha^{-1}+ 2.5 ton VC $ha^{-1}$with Dhidhessa variety (Table 3). The minimum plant height (60.17 cm), number of leaves (43.17) and number of productive branch (3.03) were recorded from unfertilized plot with Boshe variety (Table 3).

Number of leaves and number of productive branches are one of the yield traits of soybean, which provides to grain yield as well as biomass yield. The application of 75 kg NPS ha^{-1}+ 2.5 ton VC $ha^{-1}$with Dhidhessa variety was increase the number of leaves by 6.65% and number of branches by 0.53% over treatments (Table 3). This in a straight line showed incorporating combination of organic and chemical fertilizers into the soil resulting in changes on growth attributes of plant. This finding is in accordance with the results of Babulkar *et al*. (2000), who observed increased plant height, number of trifoliate leaves $plant^{-1}$ and number of branches $plant^{-1}$ in soybean due to the application of organic manure and inorganic fertilizers. Similarly, Jayabal *et al.* (2000) reported that combined treatment of vermicompost with NPK fertilizers led to an increase in number of primary branches of frenches bean (*Phaseolus vulgaris*).

The combined application of farmyard manure, vermicompost and NPS blended fertilizer significantly ($P<0.05$) increased the number of pods $plant^{-1}$ and the biomass yield (Table 4). Each single level of fertilizers of farmyard manure, vermicompost and NPS blended fertilizer had also significant effect among the soybean varieties (Table 4). Applying combined of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} was recorded the highest number of pods plant^{-1} (61.92) and the biomass (5102.30 kg ha^{-1}) with Dhidhessa variety (Table 4). This is due to the per cent of high amount of nitrogen, phosphorus and sulphur in both fertilizers. Marbaniang *et al.* (2020) was obtained similar result in mungbean using the combination of phosphorus and sulphur fertilizers. The minimum number of pods plant^{-1} (5.49 %) and biomass yield (4.23 %) increment were recorded due to application of 75 kg NPS ha^{-1}+ 2.5 ton VC ha^{-1} with Dhidhessa variety compared to all treatments.This might be due to the recovered crop nutrition through applied vermicompost with chemical (NPS) fertilizer which may result in improving vegetative growth of legume crops specifically soybean in almost of the treatments. Similarly, Devi *et al.* (2011 and 2013) reported that it might be due to adequate quantities and balanced proportions of plant nutrients in vermicompost supplied to the crop as per its need during the growth period resulting in favorable increase in yield attributing characters (biomass).

Significant effects ($P<0.05$) were shown among the yield and yield parameters, and the varieties due to the combined application of fertilizer types and rates (Table 4). The highest number of seeds plant^{-1}(2.99),hundred grains weight (20.00 g), (2536.50 kg ha^{-1}) and harvest index (54.20) were obtained from Boshe variety (Table 4). The lowest of these parameters were recorded under unfertilized plot with Boshe variety. Applying 75 kg NPS ha^{-1}+ 2.5 ton VC ha^{-1} increased the minimum number of seeds pod^{-1} by 0.01 % as compared to treatments. Sowing Boshe variety with the application of 75 kg NPS ha^{-1}+ 2.5 ton VC ha^{-1} was exceeded minimum hundred grains weight about 2.52% over treatments. This increment might be due to the positive effects of vermicompost on assimilates translocation, activation of photosynthetic enzymes, chlorophyll formation and improvement of plant growth (Kohnaward *et al.*, 2012).

Also, combined application of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} was recorded the highest grain yield (2536.50 kg ha^{-1}) with Boshe variety which increased by 15.44 % and 97.03 % over the 100 kg NPS ha^{-1} and unfertilized plot respectively (Table 4).This is due to the availability of high amount of phosphorus and sulfur in both NPS blended and vermicompost fertilizers. This is directly agreed by Marbaniang *et al*. (2020) in findings of mungbean. Vermicompost increased the soil organic carbon, phosphates, nitrates, exchangeable calcium and some other nutrients in soil for plants growth (Garcia-Gil *et al.*, 2000; Bulluck *et al*., 2002 and Jindo *et al.,* 2016) which led to higher yield of soybean. Similarly, many researchers were reported that application of vermicompost because of supplying optimum nourishment condition cause to improve growth, yield and yield components in crops [Vijaya *et al*., 2008 and Hernandez *et al.*, 2010]. Devi *et al*. (2013),Jaya bal *et al.* (2000), and Singh *et al*. (2011) reported that fertilization with integrated balanced fertilizer led to high photosynthetic efficiency and accumulation of high dry matter, which finally enhance yield parameters and grain yield.

Harvest index is the relationship of the economic yield (biomass and grain) to the total or biological yield expressed as coefficient of effectiveness. Thus, harvest index (HI) is the balance between the productive parts of the plant and the reserves, which form the economic yield. The application of 75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1} increased the minimum (14.73 %) and maximum (42.82 %) harvest index among the treatments applied with both the varieties (Table 4). This indicated that variety that produces more yield would also produce more harvest index.

Since its start in the early 1970's, fertilizer usage in Ethiopia has focused mainly on the use of nitrogen and phosphorus fertilizers in the form of urea and di-ammonium phosphate (DAP) for almost all cultivated crops. Such unbalanced application of plant nutrients may worsen the depletion of other important nutrient elements in soils. So that applying the combined form of farmyard manure, vermicompost and blended NPS fertilizer can improve the crop productivity as well as the fertility of the soil. The present study publicized that combination of organic specifically vermicompost with blended NPS fertilizer was more beneficial than using farmyard manure, vermicompost and blended NPS fertilizer separately for the grain yield and yield component of soybean varieties. Increasing the rate of blended NPS fertilizer with vermicompost combination was greatest beneficial which effectively improved grain yield and yield component of soybean varieties by improving the physical, chemical and biological properties of the soil through the nutrient content of vermicompost. The analysis of variance revealed significant effect on the soybean phenology, growth, yield and yield parameters. Using vermicompost and blended NPS fertilizer can solve the problem of the study area by increasing soybean yield and will significantly help farmers acquire better yield and to improve their economic welfare as well as greatly improve the soil fertility and nutrient content of the soil.

Table 3. Crop phonologies and growth parameters of soybean varieties affected by farmyard manure, vermicompost and blended NPS fertilizers

Treatment code	Treatments: Fertilizers	Varieties	Days to Flowering	Days to Maturity	Number of Nodules Plant^{-1}	Plant Height (cm)	Leaves number Plant^{-1} (No.)	Number of Productive Branches
T1	Zero fertilizer	Boshe	76.50^{h}	133.00^{i}	6.33^{hi}	60.17^{g}	43.17^{h}	3.03^{fg}
T2	2.5 ton FYM ha^{-1}		76.67^{h}	134.80^{h}	7.27^{gh}	69.00^{fg}	46.83^{gh}	3.33^{fg}
T3	2.5 ton VC ha^{-1}		77.17^{gh}	135.90^{gh}	8.00^{cfg}	68.58^{fg}	52.47^{cfg}	3.92d^{cf}
T4	100 kg NPS ha^{-1}		78.83^{defg}	137.67^{def}	17.77^{b}	112.25^{d}	53.00^{defg}	4.67^{cd}
T5	50 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		78.17^{g}	136.29^{g}	14.63^{d}	69.17^{fg}	61.75^{bc}	4.59^{cd}
T6	50 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		78.31^{fg}	136.62^{fg}	8.33^{ef}	112.50^{d}	59.33^{bcd}	5.69^{ab}
T7	75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		78.82^{defg}	137.64^{def}	20.00^{a}	80.58^{e}	62.33^{bc}	4.42^{cde}
T8	75 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		78.42^{efg}	136.94^{efg}	16.10^{c}	72.25^{f}	60.17^{bc}	4.50^{cd}
T9	Zero fertilizer	Dhidhessa	78.88^{cdef}	137.73^{def}	7.10^{i}	66.92^{fg}	50.33^{fg}	3.20^{fg}
T10	2.5 ton FYM ha^{-1}		78.82^{cdef}	137.97^{cde}	7.50^{gh}	110.58^{d}	56.77^{cde}	3.58^{efg}
T11	2.5 ton VC ha^{-1}		79.03^{cde}	138.08^{cde}	17.83^{b}	123.17^{bc}	60.50^{bc}	3.22^{fg}
T12	100 kg NPS ha^{-1}		82.50^{a}	145.00^{a}	17.87^{fg}	125.00^{b}	64.62^{ab}	4.92^{abc}
T13	50 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		79.30^{cd}	138.55^{cd}	14.50^{d}	122.30^{bc}	61.17^{bc}	4.67^{cd}
T14	50 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		79.56^{c}	139.12^{c}	8.50^{e}	122.67^{bc}	61.08^{bc}	4.75^{cd}
T15	75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		80.83^{b}	141.67^{b}	19.33^{b}	132.83^{a}	68.92^{a}	5.72^{a}
T16	75 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		79.00^{cdef}	138.00^{cde}	16.50^{c}	113.17^{d}	59.17^{bcd}	4.87^{bc}
Mean			78.81	137.81	12.26	93.573	56.663	4.316

Means sharing the same letter do not differ significantly at P =0.05 according to the LSD test. VC= Vermicompost, FYM= Farmyard manure, NPS= (Nitrogen, Phosphorus and sulfur) blended fertilizers.

Table 4. Grain yield and yield components of soybean varieties affected by farmyard manure, vermicompost and blended NPS fertilizers

Treatment code	Treatments: Fertilizers	Varieties	Pods number Plant^{-1}	Seeds number Pod^{-1}	Hundred grains weight (g)	Biomass yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Harvest Index (%)
T1	Zero fertilizer	Boshe	26.33^{f}	2.66^{ef}	13.00^{g}	3392.60^{h}	1287.40^{g}	37.95^{h}
T2	2.5 ton FYM ha^{-1}		45.96^{cdc}	2.74^{cdc}	18.30^{def}	4710.60^{def}	2087.80^{def}	44.32^{dc}
T3	2.5 ton VC ha^{-1}		39.83^{c}	2.89^{ab}	18.44^{def}	4629.35^{f}	2047.00^{cf}	44.22^{dc}
T4	100 kg NPS ha^{-1}		58.70^{ab}	2.81^{bc}	18.05^{efg}	4925.00^{bc}	2197.20^{bcd}	44.61^{de}
T5	50 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		42.75^{de}	2.76^{cde}	18.29^{def}	4768.00^{cde}	2166.60^{cde}	45.44^{c}
T6	50 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		42.75^{dc}	2.78b^{cdc}	18.78^{cdef}	4815.70^{cd}	2134.80^{bcd}	44.31^{dc}
T7	75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		51.93^{bc}	2.99^{a}	20.00^{a}	4680.02^{efg}	2536.50^{a}	54.20^{a}
T8	75 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		44.25^{de}	2.81^{bcd}	19.01^{cd}	4859.20^{c}	2295.70^{b}	47.24^{b}
T9	Zero fertilizer	Dhidhessa	26.07^{f}	2.57^{f}	13.50^{g}	3386.00^{h}	1287.10^{g}	38.01^{g}
T10	2.5 ton FYM ha^{-1}		29.33^{f}	2.69^{def}	18.00^{efg}	4628.90^{f}	2012.20^{f}	43.47^{ef}
T11	2.5 ton VC ha^{-1}		28.25^{f}	2.79^{bcd}	18.58^{cdef}	4828.50^{cd}	2134.80^{cd}	44.21^{de}
T12	100 kg NPS ha^{-1}		58.25^{ab}	2.73^{cdc}	17.89^{fg}	4895.12^{bcd}	2087.80^{ef}	42.65^{f}
T13	50 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		46.23^{cde}	2.71^{def}	18.55^{cdef}	4787.00^{cdf}	2058.70^{cde}	43.01^{ef}
T14	50 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		47.67^{cd}	2.83^{bc}	18.81^{cde}	4722.50^{def}	2098.90^{cde}	44.44^{de}
T15	75 kg NPS ha^{-1} + 2.5 ton VC ha^{-1}		61.92^{a}	2.98^{a}	19.93^{ab}	5102.30^{a}	2302.10^{b}	45.12^{cd}
T16	75 kg NPS ha^{-1} + 2.5 ton FYM ha^{-1}		49.22^{cd}	2.77^{bcde}	19.33^{bc}	4761.20^{cde}	2225.60^{bc}	46.74^{bc}
Mean			44.97	2.7821	18.03	4618.26	2069.39	44.37

Means sharing the same letter do not differ significantly at P =0.05 according to the LSD test. VC= Vermicompost, FYM= Farmyard manure, NPS= (Nitrogen, Phosphorus and sulfur) blended fertilizers.

REFERENCES

Albiach, R., R. Canet, F. Pomares, F. Ingelmo, 2000. Microbial biomass content and enzymatic activities after the application of organic amendments to a horticultural soil. Bioresource Technol. **75**: 43-48.

Anonymous, 2008. SAS/STAT user's guide, version 9.2. SAS institute Inc., Cary, North Carolina, USA.

Babhulkar, P.S., Wandle, W.P. Badole and S.S. Balapande, 2000. Residual Effect of long term application of FYM and of utilizes on soil properties and field of soybean. J. Ind. Soc. Soil Sci. **48**(1): 89-92.

Bulluck, L., M. Brosius, G. Evanylo and J. Ristaino, 2002. Organic and synthetic fertility amendments inûuence soil microbial, physical and chemical properties on organic and conventional farms. Appl. Soil Ecol. **19**: 147–160.

Chandrashaker, K., V. Sailaja and P. C. Rao, 2014. Effect of integrated use of organic and inorganic sources of phosphorus on soil physico-chemical and chemical properties of chickpea (*Cicer arietinum* L.). ISSN 0971-2836. J. Soils and Crops , **24** (1) : 25 - 33.

Devi, K.N., M.S. Singh, N.G. Singh and H.S. Athokpam, 2011. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). J. Crop and Weed, **7**(2):23-27.

Devi, K.N., B. Tensubam, H. Singh, S. Athokpam, N. B. Singh and D. Shamurailatpam, 2013. Influence of inorganic, biological and organic manures on nodulation and yield of soybean (*Glycine max* Merril L.) and soil properties. AJCS, **7** (9) :1407-1415.

Garcia-Gil, J., C. Plaza, P. Soler-Rovira and A. Polo, 2000, Long-term eûects of municipal solid waste compost application on soil enzyme activities and microbial biomass. Soil Biol. Biochem. **32** :1907–1913.

Habtamu, D., K.2 Taye and N.I. Amsalu, 2018. Response of Soybean (*Glycine max* (L) Merrill) to Plant Population and NP Fertilizer in Kersa Woreda South Western Ethiopia. Int.J.Curr.Res.Aca. Rev.**6** (9): 50-71.

Hartman, G.L., E.D. West and T.K. Herman, 2011. Crops that feed the World 2. Soybean- worldwide production, use and constraints caused by pathogens and pests. Food Sci. **3**: 5-17.

Hernández, A., H. Castillo, D. Ojed, A. Arras, J. López and E. Sánchez, 2010. Effect of vermicompost and compost on lettuce production. Chil. J. Agric. Res. **70** (4): 583-589.

Ibrahim, S.E. 2011. Soybean: Crop of hope in Sudan. Symposium of Korean Society of International Agriculture, Suwon, Republic of Korea, June 21.

Jayabal, A., S.P. Palayyappan and S. Chelliah, 2000. Effect of integrated nutrient management techniques on yield attributes and yields of sunflower (*Helianthus annuus*). Ind. J. Agron. **45** (2): 384 - 386.

Jindo, K., C. Chocano, J. M. De Aguilar, D. Gonzalez, T. Hernandez and C. Garcia, 2016. Impact of compost application during 5 years on crop production, soil microbial activity, carbon fraction, and humification process. Commun. Soil Sci. Plant Anal. **47**: 1907–1919.

Joshi, R., J. Singh and A. P. Vig, 2014. Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants. Rev. Environ. Sci. Biotechnol. ISSN 1569-1705. DOI 10.1007/s11157-014-9347-1

Kaul, A.K. and M.L. Das, 1986. Oilseeds in Bangladesh.Bangladesh, Canada Agriculture Sector Team, Ministry of Agriculture, Govt. Of the People's Republic Bangladesh, Dhaka, pp. 324

Kibiru, K. 2018. Effect of Inter Row Spacing on Yield Components and Yield of Soybean [*Glycine max* (L.) Merrill] Varieties in Dale Sedi District, Western Ethiopia. Agri . Res. & Tech: Open Access J. **18** (4) : ARTOAJ.MS.ID.556068.

Kohnaward, P., J. Jalilian and A. Pirzad, 2012. Effect of foliar application of micro-nutrients on yield and yield components of safflower under conventional and ecological cropping systems. I.R.J. Applied and Basic Sci. **3**(7) : 1460-1469.

Langemeier, M. and R. Purdy, 2019. International Benchmarks for Soybean Production. farmdoc daily (9): 94, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, May 22, 2019.

Lourduraj, C .A. 2000. Effect of irrigation and manure application on growth and yield of groundnut. Acta Agron. Hungarica, **48**: 83-88.

Marbaniang, E.E., Ao E., Sentimenla, Y. Gadi, and A.K. Singh, 2020. Effect of phosphorus and Sulphur on growth, yield and yield quality of mungbean (*Vigna radiata* L. Wilczek). ISSN 0971-2836. J. Soils and Crops, **30** (1) : 56 – 62.

Moghadam, M., K.,H.H. Darvishi and M. Javaheri, 2014. Evaluation agronomic traits of soybean affected by vermicompost and bacteria in sustainable agricultural system. Int. J. Biosci. IJB. **5** (9) : 406-413.

Parthasarathi, K., L.S. Ranganathan, V. Anandi and J. Zeyer, 2007. Diversity of microflora in the gut and casts of tropical composting earthworms reared on different substrates. J. Env. Biol. **28** : 87-97.

Singh, B.K., K.A. Pathak, A.K. Verma, V.K. Verma and B.C. Deka, 2011. Effects of vermicompost, fertilizer and mulch on plant growth, nodulation and pod yield of French bean (*Phaseolus vulgaris* L.). Veg. Crop Res. Bull. **74** :153–165.

Smith, K. J. and W. Huyser, 1987. World distribution and significance of soybean. In: J.R. Wilcox (ed.), Soybean: Improvement, Production, and Uses, second ed. No. 16, pp. 1-22.

Tadesse, G. and A. Sentayehu, 2015. Genetic Divergence Analysis on Some Soybean (*Glycine max* L. Merrill) Genotypes Grown in Pawe, Ethiopia. American-Eurasian J. Agric. & Environ. Sci. **15**(10): 1927-1933.29.

Vijaya, D. , S.N. Padmadevi, S. Vasandha, R.S. Meerabhai, P. Chellapandi, 2008. Effect of vermicomposted coirpith on the growth of F *Andrographis paniculata.* J. Syst. **3** (2): 51-56.

Rec. on 02.12.2020 & Acc. on 28.12.2020