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Research Article

The effect of different type of vermicompost organic fertilizer litter on quantitive, qualitative and biochemical characteristics of green mung bean (Vigna radiata L.) in drought stress conditions in Varamin

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ABSTRACT

Vermicompost in sustainable agriculture is very useful for improving soil porosity and thereby providing more nutrients to plants; accordingly, a split plot experiment was performed on mung bean in a randomized complete block design from with three replications in research farm of Islamic Azad University, Varamin – Pishva. The first factor was drought stress including lack of drought stress, irrigation cut in podding stage and irrigation cut in grain filling stage as the main plot and the second factor was vermicompost including non-consumption, vermicompost with cattle litter, vermicompost with cattle and equine litter, as well as vermicompost with cattle, poultry and equine litter as sub plot. Based on the results of analysis of variance, the main effect of drought stress and grain yield vermicompost, biological yield, protein yield, proline and cell membrane stability was significant at one percent probability level. Additionally, drought stress was significantly effective on protein percentage at one percent probability level as well as on leaf relative water content and protein percentage at five percent probability level. The results showed that with increase in drought stress, grain yield, biological yield, protein yield, leaf relative water content and membrane stability decrease and protein and proline percentage are added, so that the most negative effect in irrigation cut occurred in podding stage. It was also found that vermicompost in the presence or absence of drought stress improves yield and drought yield components, so that vermicompost with cattle and equine litter, as well as with cattle, poultry and equine litter had the greatest impact.

Keywords: protein, proline, drought stress, vermicompost, mung bean.

INTRODUCTION

The increasing need of society to food and irregular growth of the population and reduction of food sources is one of the most important issues that has attracted politicians, thinkers and researchers' attention. Iran will need food approximately 2 times more than the current figure until another 20 years with current consumption level. The population growth and economic and social development of the country in the past two decades has led to a dramatic increase in the consumption of protein, especially red meat. Accordingly, the increased production of protein substances, especially plant proteins which are more valuable sources in nutrition, is inevitable. Legumes, by having approximately 20% of protein and sometimes more, play an important role in providing the protein needed by human beings, especially in countries with low animal and agricultural products. Legumes in human nutrition can be considered as a good dietary supplement for cereals (Majnoon-hosseini, 1996). These plants are also valuable as alternative crops, but little attention has been paid in farming methods and agricultural researches (Ahmad, 2008). Mung bean with scientific name of Vigna radiate L. is called by the names of Green gram, Mung bean or Golden gram in English (Koochaki, 1989). Water deficit stress is one of the main obstacles in the production of horticultural and field crop in many parts of the world, especially in arid and semi-arid areas like Iran (Sadeghipour, 2009). The use of organic fertilizers like vermicompost, while maintaining environmental health, enhances product quality, soil moisture and improves the soil structure (Sharma, 2003). Vermicompost has many characteristics such as high porosity, ventilation and proper drainage, high moisture absorption and maintenance power, high uptake level for water and foodstuffs, and its use in sustainable agriculture is very useful to improve soil porosity and thus more availability of nutrient elements required by plants. In fact, the superiority of vermicompost compared to other organic fertilizers is that its structure has changed well and the number of plant pathogenic microorganisms in it has strongly decreased (Claudio et al., 2009).

Vermicompost has a high ability to attract and retain water and nutrient elements and consequently, high porosity, good ventilation and drainage; and its use in sustainable agriculture, in addition to increase of population and activity of soil's beneficial microorganisms such as mycorrhiza fungi and bacteria in the rhizospheresuch as microorganisms solubilizing phosphateprovides nutrient elements for plantssuch as nitrogen, phosphorus and soluble potassium and improves the growth and yield of crops (Arancon et al., 2004).

Mollazahi and colleagues (2013) in a study entitled "investigating the effects of biological fertilizers on quantitative and qualitative characteristics of mung bean under drought stress conditions" showed that drought stress had a significant influence on protein percentage, proline, leaf relative moisture content and grain sodium content and had no significant effect on the amount of potassium. With increase in stress, the amount of all parameters except sodium was reduced. The impact of fertilizers on the amount of relative humidity and potassium was significant and no significant effect was observed on protein, sodium and proline. The greatest amount of protein was obtained from mycorrhizal treatment 2. The highest amount of sodium and potassium was obtained under the influence of fertilized phosphate 2and control respectively.

Lali Nia et al (2014) conducted an experiment in order to investigate and determine the most appropriate cultivar and stage of drought stress treatment on mung bean. The results showed that among the different stages of growth, the highest rate of desired traits was obtained from stress treatment during grain growth stage. The greatest amount of grain yield, seed weight, number of pods per plant and number of seeds per pod among under study cultivars pertained to the radiata cultivar. In general, it can be said that the greatest effect of drought stress is at flowering stage that the highest yield loss would be at this stage.

In order to investigate the effect of bio-fertilizer (mycorrhizal species) under different levels of phosphorus fertilizer on yield and yield components of mung bean, experiments were conducted. An experiment was conducted to investigate the effect of bio-fertilizer (mycorrhizal species) on yield and yield components of mung bean under different levels of phosphorus fertilizer. The results showed that the biomass yield was affected by different levels of phosphorus fertilizer. The highest biomass yield was obtained from applying 100 and 150 kg per hectare of phosphate fertilizer. The Mycorrhiza species had significant effect on grain yield, number of pods per square meter, biomass yield and pod weight. With regard to the obtained results it can be concluded that combinational application of mycorrhizal fungi associated with phosphorus fertilizer has a significantly positive effect on all traits except number of seed per pod (Khosravi et al., 2014).

The results of study conducted by Ramroudi and Mollazahi (2013) on the mung bean under the influence of bio-fertilizer showed that drought stress and bio fertilizer had a significant effect on visible bud date, number of days from planting to 50% of flowering, number of days from planting to ripen the first pods, number of days from planting to maturity, plant height, seed weight, biological yield and grain. The highest increased grain yield was obtained from fertilized bio-phosphate 3. The highest seed weight was achieved from interaction between irrigation control treatment and fertilized biological fertilizer 3.

Moradi et al (2008) during an examination investigated the effect of different times and intensities of drought stress on total mung bean dry matter and its sharing to various organs and declared that drought stress at different growth stages reduced the amount of dry matter production. The stress treatments at vegetative growth stage increased partitioning percentage of total dry matter to shoot, while the same treatments led to a decline in leaf share from dry matter at the end of vegetative stage. The treatments of drought stress at the reproductive stage decreased share of leaves and pods from the final dry matter. However, the effect of stress treatments at the vegetative stage on final dry matter weight and dry matter partitioning was more than stress treatments at the reproductive stage. The Percentage final dry matter partitioning to pods, leaves and stems was highly correlated with final dry weight of these organs.

Hashemi and colleagues (2014) conducted an experiment to evaluate the effect of fertilized phosphate bio-fertilizers - 2 and vermicompost on yield and yield components of mung bean. The results showed that the highest plant height and root length has pertained to 30 tons per hectare vermicompost interaction treatment along with fertilized phosphate biological fertilizer -2 at a dose of 100 grams per hectare with average of 66.74 and 51.66 cm respectively. Based on the obtained results, the highest root and shoot weight has pertained to 30 tons per hectare vermicompost treatment along with fertilized phosphate biological fertilizer -2 at a dose of 100 grams per hectare with average of 17.1 and 61.5 grams respectively.

MATERIALS AND METHODS

This experiment was carried out in crop year of 2013-2014 at Agricultural Research Station of Islamic Azad University of Varamin - Pishva. The aim of this study was to investigate the effect of vermicompost on quantitative, qualitative and biochemical characteristics of radiate cultivar mung bean under drought stress conditions in Varamin. A split plot experiment was carried out in a randomized complete block design in 3 iterations. The treatments used in this study were: Drought stress as the main plot at three levels of non-drought stress (control), irrigation cut in podding stage and irrigation cut at grain filling stage and a variety of vermicompost as subplots in four levels of non-consumption (control), vermicompost fertilizer with cattle litter, vermicompost fertilizer with cattle and equine litter and vermicompost fertilizer with cattle, equine and poultry litter. The seed used for planting was radiata cultivar Mung bean provided from a Seed and Plant Institute located in Karaj.

Each treatment consisted of 6 planting lines with 60 cm distance with a length of 4 m. Lines 1 and 6, half a meter from each side were used as margin, line 2 for sampling level, line 3 as yield margin and lines 4 and 5 were used as crop yield. Total land area was 700 square meters, distance between the main plots was 120 cm, 1 meter between sub-plots and 1 meter between repetitions. The primary irrigation was carried out after sowing the seeds and subsequent irrigations were done in 40%of soil moisture depletion (MAO) until applying drought stress. Also, treatments of irrigation cut at podding stage and full irrigation received respectively 2 and 4 times more irrigation than treatments of irrigation cut at flowering stage.Cultivation was carried out in some sub-plots as required. Also, the dominant broadleaf weed (pigweed) of the area was driven out in three turns through hand weeding. After the end of experiments, data analysis was carried out using statistical software SAS (Version 9.1) and mean comparison was done by Duncan test at 5% probability level.

RESULTS AND DISCUSSION

Grain yield

The results obtained from variance analysis (Table 1) revealed that the effect of vermicompost and drought stress at 1% probability level has been significant on grain yield, but no significant effect was observed in mutual effect of vermicompost with drought stress. The information obtained from the results of the comparison of the grain yield average under drought stress factor showed that grain yield reduces by applying drought stress, such that the highest grain yield by 21132.76 kg per hectare pertains to the absence of drought stress and lowest grain yield by 1536.39 kg per hectare is related to irrigation cut in podding stage (Table 2). Based on the results obtained from the comparison of the grain yield average under the influence of vermicompost factor (Table 3), grain yield increased compared to control, so that the highest grain yield by 1872.26, 1948.59 and 1964.55 kg per hectare was obtained respectively from vermicompost treatment with cattle litter, cattle and equine litter and cattle, equine and poultry litter and lowest grain yield by 1409.26 kg per hectare has been achieved in control treatment.

The use of vermicompost has positive effects on grain yield. The favorable effect of Vermicompost is probably due to the relatively higher amounts of nutritional elements and hence the increase in availability of macro and micro nutritional elements (jat & Ahlawat, 2008). The yield increase is probably due to high amount of available nitrogen which is essential for the production of structural proteins. In addition to nutritional elements and organic materials, vermicompost contains a large quantity of humic substances that these materials enhance plant growth and yield through improving bioavailability of certain nutritional elements, especially iron and zinc (Chen et al., 2004). The most valuable feature of vermicompost is in the performance of enzymes, microorganisms and different hormones in it. Vermicompost has enzymes such as protease, amylase, lipase, cellulase and Pectinase that have an effective role in decomposition of organic matter in the soil and thus making available the nutrients required by plants and enhance the performance by providing a suitable growth medium (Jat & Ahlawat, 2006). It is reported that the use of only 2,500 kilograms of vermicompost per hectare wheat farm has a better result compared to chemical fertilizers. Vermicompost could also reduce plant's water requirement by about 30 to 40 percent (Suhane et al., 2008). The researchers concluded that the lack of water after flowering stage severely affect the growth and development of reproductive organs and reduce the grain yield (Gholinejad et al., 2009). So it seems that the yield of crops under drought stress conditions is due to the achieved improvement in physical and chemical properties of soil as a result of the use of vermicompost bio-fertilizers (Rahbarian et al., 2010).

Biological yield

The results of variance analysis showed that vermicompost and drought stress at one percent possibility level have a significant effect on the biological yield, but the interaction of vermicompost with drought stress has no significant effect (Table 1). Based on the results obtained from the comparison of biological yield average affected by drought stress factor in the presence of biological yield, drought stress is reduced so that the highest biological yield by 8452.22 kg per hectare in the absence of drought stress and lowest biological yield by 6001.37 kg per hectare pertains to irrigation cut at pod filling stage (Table 2). The results obtained from the comparison of average of biological yield affected by vermicompost factor suggests that biological yield increases by applying vermicompost, so that the highest biological yield by 7914.46 kg per hectare pertains to vermicompost treatment with cattle, poultry and equine litter and lowest biological yield by 5613.35 kg per hectare is related to the absence of vermicompost (table 3).

It seems that biological yield under drought stress conditions is due to the improvement in physical and chemical properties of soil as a result of the use of vermicompost bio-fertilizers (Rahbarian et al., 2010). The researchers expressed that positive reason of vermicompost on the growth of plants is the existence of aerobic microorganisms as well as materials such as peat with high water holding and aeration capacity and nutrient uptake levels in this fertilizer (Jashankar & Wahab, 2004). They have reported that vermicompost fertilizer increases the yield components and biological yield through stimulation of activity of the soil's beneficial microorganisms and continuous and stable supply of mineral elements, especially nitrogen to the plant (Cavender et al., 2003).

Zabet and Hosseinzade (2011) reported that the reduction in plant height and number of nodes per stalk cause drought stress decreases cellular proliferation and vegetative growth of the plant and thereby reduction of plant's biological yield. the drought stress and reduction of leaf area through reducing cell divisions and Turgor and enlargement and impact on whole plant growth, reduction of plant height and leaf loss, as well as decrease in stomatal conductance for avoiding waste of water and thus attracting less carbon dioxideand effect of stress on chlorophyll decrease Photosynthesis. As a result, biological yield which is as a reservoir determining the amount of grain yield is affected. The increased dry matter produced in plants under favorable irrigation conditions could be due to further expansion of leaf area and the durability of its leaf area that has increased production of dry matter by creating efficient physiological source for maximum use of received light (Lak et al., 2007). The reason for reduction of whole plant yield caused by reduction of actual photosynthesis has been reduction of leaf area index caused by stress (Dillo et al., 2001). The drought stress coincides with the active vegetative growth of shrubs delays plant's organ development. The reduction of plant size leads to decrease of cultured material production. Therefore, dry matter production in plantdepends on the size of its photosensitizer's surface (Emam & Nicknejad, 2004).

The percentage of protein

Based on the results of analysis of variance (Table 1), drought stress at 1% probability level and vermicompost at five percent probability level have a significant effect on the percentage of protein, but the interaction of vermicompost with drought stress is not effective significantly.

The results obtained from the comparison of the average of protein percentage affected by drought stress factor (Table 2) showed that the highest protein percentage by 28.42% in irrigation cut has been obtained in podding stage and the lowest percentage of protein by 24.3136 and 25.57 percent respectively in control and irrigation cut has been achieved in grain filling stage.

The results obtained from the comparison of the average of protein percentage affected by vermicompost factor indicate that with the use of vermicompost, protein percentage increases compared to control, such a way that the highest protein percentage by 26.24, 27.05 and 27.02 percent is respectively related to the use of vermicompost with cattle litter, cattle and equine litter and cattle, equine and poultry litter, and the lowest percentage of protein by 24.15% pertains to the control treatment (table 3).

Nitrogen and residue phosphorus and waste of Eisenia foetida are often 5 upto 11 times more than the soil and other macro and micro nutrient elements in it are also more than the amount of the elements in soil; on the other hand, secretions of digestive system of worms is able to convert nutrient elements with low accessibility to accessible elements for plant absorption (Arancon, 2005). The use of vermicompost has positive effects on the amount of protein and nutrient uptake by the plant. The favorable effect of vermicompost is probably due to relatively higher amounts of nutritional elements and hence increase in availability of macro and micro nutrients which leads to increased protein percentage (jat & Ahlawat, 2008). The results indicate that the increase in the protein percentage was at the presence of drought stress that is consistent with the results of study conducted by (Si, 2006; Rahnama & Bakhshande et al., 2003).It also indicated that drought stress reduces the accumulation of carbohydrate and increases protein content (Bahrani et al., 2009).

Protein yield

The information obtained from the analysis of variance showed that the effect of vermicompost and drought stress at one percent probability level on the function of the protein has become significant, but the interaction of vermicompost with drought stress has not been significant (Table 1).

The results obtained from the comparison of the average of protein yield under effect of drought stress (Table 2) showed that the highest protein yield by 523.61 kg per hectare has been at the absence of drought stress and lowest protein yield by 439.31 and 441.97 kg per hectare pertains to irrigation cut at podding stage and seed filling stage respectively.

Based on the results obtained from the results of comparing average of protein yield under the influence of vermicompost factor with the use of vermicompost, we are seeing an increase in protein yield compared to control, such that the highest protein yield is to relate to the application of vermicompost with different litters and lowest protein yield by 336.59 kg per hectare pertains to control treatment (Table 3).

The obtained results correspond with the results of Johnson et al (2002) that during their study reported that drought stress is one of the most important factors which can effectively affect protein yield and reduce it and it is due to the reduction of grain yield. The results indicate that the increased protein content and protein yield reduction due to reduced grain yield was at the presence of drought stress that is consistent with the results of (Si et al., 2003; Rahnama & Bakhshande, 2006). The use of vermicompost increases protein yield, probably this increase is due to the relatively higher amounts of nutrients and increased grain yield (jat & Ahlawat, 2008).

Leaf relative water content

The results obtained from analysis of variance indicated that drought stress had a significant effect on leaf relative water content at one percent probability level, but vermicompost and the interaction of vermicompost with the drought stress does not have a significant effect on the leaf relative water content (Table 1). The information obtained from the results of the comparing the average of leaf relative water content under drought stress factor showed that the highest leaf relative water content by 84.38 and 82.86 percent has been in control treatment and irrigation cut at grain filling stage respectively and the lowest leaf relative water content by 77.35 percent has been obtained in irrigation cut at podding stage (table 2).

Leaf relative water content is one of the features affecting growth continuation under drought conditions, and the amount more than it can be a for growth continuation factor in drought conditions (Kumar & Singh, 1998). Given the high correlation between water absorption potential and Leaf relative water content, Leaf relative water content decreases following the drought and decrease in water absorption potential, (Paseban-Islam et al., 2000). In this study, leaf relative water content decreases by drought stress treatment that is in line with with the results of (Atteya, 2003). The researchers have expressed delay in root growth and its activity as well as increased evapotranspiration as reasons for decrease in leaf relative water content (Tarumingkeng & Coto, 2003).

Leaf relative water content in drought stress treatment and filling stage was alike and did not show a significant difference; but in podding stage, leaf relative water content has declined that this case can be justified with regard to the resources mentioned above. In the podding stage, due to plant growth, delay in root growth and its activity as well as increased evapotranspiration rate it been affected by drought stress and relative water content rate has dropped. But in grain filling stage, plant completes its vegetative growthand roots will no longer grow and hence there is no difference between drought stress treatment and grain filling stage. The leaf relative water content rather means leaf's ability to maintain larger amounts of water under drought stress conditions. It is also a good indicator for selection for drought resistance. Because, in drought stress conditions, leaf relative water content decreases due to high plant transpiration and evaporation from soil surface. With regard to the obtained results it can be concluded that in irrigation and stress condition, leaf relative water content has increased by increase of corresponding treatments compared to control.

The reason for this is that under conditions of using vermicompost fertilizer, the plant keeps more relative water in its leaves and causes increase in leaf relative water rate. So, the use of vermicompost fertilizer in irrigation and stress condition makes the plant to increase its stomatal resistance and water holding capacity especially in leaf tissue by absorbing water and nutrients, especially (phosphorus and potassium) (Taherianfar et al. , 2011).

Proline

The results of analysis of variance (Table 1) showed that the effect of vermicompost and drought stress on proline at 1% probability level is significant, but the interaction of vermicompost with drought stress has not been significant. Based on the results of comparing the average of proline affected by drought stress factor, drought stress increases proline accumulation. The maximum protein by 5.53 mg per fresh weight gram has been in irrigation cut at podding stage and the least proline by 2.63 mg per fresh weight gram has been obtained in control treatment (Table 2). The information obtained from the results of comparing the average of proline under the influence of vermicompost factor (Table 3) showed that with the use of vermicompost we are seeing a decline in proline compared to control, such that the maximum amount of proline by 6.74 mg per fresh weight gram is related to control treatment and the minimum proline pertains to vermicompost treatment with different litters.

Proline as a soluble substancecauses regulation of osmotic pressure, reduction of water loss from the cell, protection of cellular inflammation, reduction of retarding effect of ions on enzymes' activity, preventing fragmentation of different proteins (possibly through control of cells pH), increase in durability of some cytoplasmic and mitochondrial enzymes, stability of proteins' natural form and therefore protection of membrane systems. In plants, the accumulation of proline as a result of exposure to water stress conditions, is a common phenomenon (Costa & Morel, 1994). proline is one of the amino acids in osmotic adjustment phenomenon that plays an important role in creating and maintaining osmotic pressure inside the plant. The results showed that drought stress increased proline accumulation. The increase of Proline in plant at stress time is a kind of defense mechanism. Proline increases the tolerance of plants against stresses through osmotic adjustment, preventing enzymatic degradation and clearing hydroxyl radicals that corresponds with the results of Kuznetsov & Shevykova (1997).

Cell membrane stability

The results of analysis of variance (Table 1) showed that the effect of vermicompost and drought stress on cell membrane stability t 1% probability level has been significant, but the interaction of vermicompost with drought stress has not been significant. Based on the comparison of the average of cell membrane stability influenced by drought stress factor (Table 2), drought stress reduced the stability of the membrane, so that maximum stability of the cell membrane by 401.53 µmhos / cm has been in control treatment and minimum stability of cell membrane by 227.92 µmhos / cm in irrigation cut has been achieved at podding stage.

The information obtained from the results of the comparison of cell membrane stability average under the influence of vermicompost factor showed that with the use of vermicompost, the stability of cell membrane increases compared to control treatment, so that maximum stability of the cell membrane by 297.21 µmhos / cm, 326.54 and 322.58 respectively pertains to vermicompost with cattle litter, cattle and equine litter and cattle, equine and poultry litter and least stability of cell membrane by 257.32 µmhos / cm is related to the control treatment (table 3).

Production and accumulation of toxic oxygen species such as superoxide radicals, hydrogen peroxide and hydroxyl radicals in drought stress conditions damage many cellular components such as lipids, proteins and nucleic acids (Jiang & Huang , 2001), and cell membrane damages from peroxidation of lipids (Liang et al., 2003). In this study, cell membrane stability reduced by drought stress, similar results have been obtained by (Saneoka et al., 2004).

Table 1. The results obtained from analysis of variance of the effect of various vermicompost organic fertilizer litters on quantitative and qualitative and biochemical characteristics of green mung bean at drought stress conditions in Varamin

Sources of changes	Degrees of freedom	grain yield	Biological function	percent age of protein	Protein yield	leaf relative water content	Proline	Membrane stability
Block	2	3562/28^ns^	393518/34^ns^	3/52^ns^	2503^ns^	69/46^ns^	2/29^ns^	2004/54^ns^
(Drought stress (a	2	/31** 1113415	18820145/16**	52/18**	27553/49**	164/28*	25/5**	97296/78**
Error	4	28439/44	223994/03	0/33	1708/73	46/28	0/36	273/14
vermicompost (b)	3	/26** 621141	9192019/07**	16/66*	73290/25**	68/81^ns^	26/86**	9119/14**
a*b	6	/05^ns^ 20461	273237/13^ns^	3/4^ns^	1738/06^ns^	3/1^ns^	1/16^ns^	1897/13^ns^
Error	18	29129/44	304007/82	3/76	3419/53	28/64	0/98	1519/23
CV%		9/49	7/79	7/43	12/49	6/56	23/75	12/95

* And **: significant at five one percent probability level respectively ns: no significant effect.

Table 2: comparison of the average of drought stress effect on quantitative and qualitative and biochemical characteristics of Mung bean in Varamin

Drought stress withholding) (irrigation	grain yield (kg/ha)	Biological function (kg/ha)	percentage of protein %	Protein yield (kg/ha)	leaf relative water content %	Proline Mg/gfw	Membrane stability µmhos/cm
No drought stress	2132/76^a^	8452/22^a^	24/36^b^	523/61^a^	84/38^a^	2/63^c^	401/53^a^
podding	1536/39^c^	6001/37^c^	28/42^a^	439/31^b^	77/35^b^	5/53^a^	227/92^c^

Grain filling	1726/84[b]	6779/52[b]	25/57[b]	441/97[b]	82/86[a]	4/32[b]	273/29[b]

Averages with common letters are not significantly different according to Duncan test at 5% probability level.

Table 3. The comparison between averages of the effect of different vermicompost organic fertilizer litters on quantitative and qualitative and biochemical characteristics of Mungbean in Varamin

vermicompost	**grain yield (kg/ha)**	**Biological function (kg/ha)**	**percentage % of protein**	**Protein yield (kg/ha)**	**Proline Mg/gfw**	**Membrane stability** μmhos/cm
Non-consumption	1409/26[b]	5613/35[c]	24/15[b]	336/59[b]	6/74[a]	257/32[b]
Cattle litter	1872/26[a]	7285/24[b]	26/24[a]	483/05[a]	3/52[b]	297/21[a]
cattle and equine litter	1948/59[a]	7497/76[ab]	27/05[a]	523/19[a]	3/21[b]	326/54[a]
Cattle, equine and poultry litter	1964/55[a]	7914/46[a]	27/02[a]	530/36[a]	3/17[b]	322/58[a]

Averages with common letters are not significantly different according to Duncan test at 5% probability level.

CONCLUSION

The present study revealed that the use of vermicompost is useful for the growth of green mung bean. Vermicompost increased grain yield, biological yield, protein yield, cell membrane stability, and reduced the accumulation of proline. Additionally, cattle and equine litterhad a greater impact on yield and yield components of green mung bean. According to the results of drought stress, green mung bean was planted with the increase of drought stress yield and yield components. It was also found that drought stress reduced yield and yield components and increases accumulation of proline and irrigation cut in podding stage had the most negative effect on the plant. Considering the results obtained in relation to the interaction of vermicompost and drought stress, it can be concluded that the application of vermicompost has beneficial effects on plant green mung bean to increase the yield and yield components of green mung bean in the absence of drought stress and as well as the presence of drought stress.

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