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The interaction effect of nitrogen and vermicompost on chickpea yield and yield components in Hamedan region

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ABSTRACT: In order to investigate the effect of nitrogen and vermicompost on chickpea yield and yield components in Hamedan region, an experiment as a factorial form in the randomized complete block design in 2014 was conducted. The first factor nitrogen at three levels was included 0, 90and 120kg.ha^{-1} and the second factor vermicompost at two levels was included lack of control and 15ton.ha^{-1}. Nitrogen and vermicompostat one percent probable was affected all studied characteristic, as well as the interaction effect of nitrogen concentration with vermicompost at five percent probable has a significant effect on the seed number in plant, seed hundred weight and seed yield, but no significant effect on plant height, number of pods per plant and biological yield was observed. According to research results, 90 and120 kg nitrogen per ha had the most positive effect on the measured characteristics. Also the using of vermicompost was increased the yield and yield components of chickpea.

Keywords: Chickpea, nitrogen, vermicompost, seed yield.

INTRODUCTION

Legumes dry seeds are eatable that belongs to the legume family and they are under Papilionaceae family. Dry and ripe seeds of legumes have a high nutritional value and a good ability tohold and one of the major sources and is rich in protein, chickpea is an important source of vegetable protein and one of the legumes that has an important role in the human diet (Zaidi *et al.*, 2003). Chickpea (*Cicer arietinum* L.) is one of cold like legumes that today its cultivation more than 10 million hectares of the world's land is devoted to itself (FAO, 2004). Chickpea is contained large amounts of Lysine and Tryptophan amino acids that their amount is lower than in cereals, this plant is included high protein percent and carbohydrate amounts and the amounts of fiber is low in it (Chapman, 2001). Trypsin inhibitors in Chickpea 5 to 20% is lower than in soybean that it allows direct feeding to livestock without preparation process (Schneider, 2002). The use of chickpea as a cover plant protects from erosion and improves soil quality and prevents the loss of water by evaporation or washing (Rice *et al.*, 1993). Chickpea is legume that in the farms as suppliers of protein for livestock feed and human consumption is cultivated. If the soil is unable to provide enough nutrients for plants, the using of soil modifiers is required.

The Davis and Wilson research (Davis *et al.*, 2004) were revealed that organic matter of soil aeration, water penetration, water and nutrients holding capacity in the soil are increased. Vermicompost as an appropriate power and cost-effective organic fertilizer and valuable can be as a suitable alternative in the sustainable agriculture and organic cultivation have a special place (Sumner, 2000). Vermicompost is an organic material such as peat that causes soft tissue and increase soil aeration, moisture absorption and water holding capacity. Organic carbon in the Vermicompost is released nutrients slowly and steadily in the plant growth system the plant is able to absorb it (Alikhani *et al.*, 2006). The use of vermicompost in sustainable agriculture in addition to increasing the support and beneficial soil microorganisms in order to provide plant required nutrients such as nitrogen, phosphorus and soluble potassium is not acted and is improved the crop growth and yield. In a study on barley, it was found that the using of vermicompost increases the biological performance (Kumawat *et al.*, 2006). In an experiment that was conducted on corn and chickpea, it was indicated that the using of vermicompost, increase biological performance, seed yield and quality in comparing with control (Jat *et al.*, 2006).

The researchers found that the using of 10 ton.ha^{-1} vermicompost and along with using the 100% common chemical fertilizer of region were increased the number of sub branches, stem diameter, number of pods and yield in the chickpeas (Reddy *et al.,* 1998). Researchers also maintain the yield reasons increasing by vermicompost and state the maintenance of soil nutrient elements and prevent the removal of nitrogen by water, increase the biological activity and improve soil structure (Roesty *et al.,* 2006).

The researchers said that the using of nitrogen fertilizer, increases leaf area index and soybean production, also increases dry matter production and final seed yield per unit area (Ghalambaran *et al.,* 1996). In researchers experiments (Schneider, 2002) chickpea yield and yield components increased by increasing nitrogen levels. Yield components such as the number and pod weight, seed weight per plant and seed thousand weight were significantly affected by nitrogen using. They also stated that this increase may be due to a higher allocation of photosynthesis material for productive part. The increasing of nitrogen using increases the plant height, number of sub branches and dry weight that was significantly more than the control. In another study, seed yield to the most amount of nitrogen using was increased. Nitrogen significantly was increased the number of total pods and also the number of fertile pods (Saini and Faroda 1998), but the number of seeds per pod and seed thousand weight was not significantly affected by nitrogen using. The purpose of this study was to evaluate the effect of nitrogen chemical fertilizer along with biological fertilizer of vermicompost on yield and yield components on the spring rain fed chickpea in Hamadan.

MATERIALS AND METHODS

This experiment in farming year of 2014 in the rain fed fields of Gharah Daie village of Hamedan province, in the 100 kilometers Saveh-Hamedan freeway was conducted. This experiment as a factorial form in a randomized complete block design with three replications was conducted that nitrogen fertilizer factor was included zero (control), 90 and 120 kg nitrogen of 46% and vermicompost factor was included zero (control) and 15 ton.ha^{-1} of vermicompost. In order to implement the experiment, the ground to a depth of 30-25 cm was plowed and was prepared to planting, each plot has six rows planting, the distance between the plots was 0.5 m and the distance between the blocks was considered one meter that in the distance of every sub-plots one row is not planted and were abandoned. Planting by hand and the row with a distance of 10 cm and the distance between rows 25 cm in the Gharah Daie village of Hamedan province in the spring of 2014 were conducted.

Table 1: Geographical and climatic location of experiment implementation.

Longitude **Latitude**	**48°9´** **36°21´**
Above mean sea level	1219 m
The average rainfall	280-350 mm
Soil tissue	*Sandy*clay
The average annual temperature	22.6 and 5.9 °C

Of course all of phosphorus fertilizer was used for each treatment before planting and a third nitrogen fertilizer for each treatment before planting, and the remaining during two turn in the stem elongation and flowering stages and simultaneously with rainfall precipitation was used and vermicompost before planting and in amount of 15 ton.ha^{-1} was given to the soil. The used cultivar in this study is Hashemi cultivar that is one of the rains fed cultivar and has medium height, preterm, with white flowers and resistant to drought. Its growth period in spring planting is depending on the spring rain from 70 to 140 days and its seed thousand weight is about 350 gr. The required seed also was prepared from the Seed and Plant Institute in Karaj. Fighting with weeds was done manually. Thinning operation was performed at stem elongation stage. Top dress fertilizer also in two stages and simultaneously with the rainfall precipitation was used. Seed yield after collecting samples and pods when were at full maturity before falling seed, attempted to harvest mid plant lines from each plot and after thrashing by digital scale, seed yield of the all plants was measured. It is noteworthy that before harvesting seed yield attempted to harvest 5 plants in each plot randomly and all yield components characteristics according to obtained average number from this 5 plant was achieved. Data analysis by using SPSS software and mean comparison treatments in Duncan Multiple range test at five percent probable was conducted.

RESULTS

Plant height: the variance analysis results (Table 2) showed that nitrogen and vermicompost effects at one percent probable was significant on plant height, but the interaction effect of nitrogen with vermicompost on the plant height was not significant. Based on mean comparison of the plant height (Table 3) by the using of nitrogen was increased the plant height. Also the using of vermicompost was associated with an increase in plant height (Table 4). According to the obtained results in Table 5, the most plant height of 90 kg nitrogen per ha with 15 ton.ha^{-1} of vermicompost was obtained.

The number of pods per plant: according to the variance analysis results (Table 2) the effects of nitrogen and vermicompost at one percent probable on the number of pods per plant had a significant effect, but the interaction effect of nitrogen with vermicompost on the number of pods per plant had not a significant effect. The obtained information from the mean comparison results (Table 3) showed that the using of nitrogen fertilizer was increased the number of pods per plant. The results also (Table 4) indicated that the using of vermicompost was increased the number of pods per plant. As well as the most number of pods per plant in the presence of 15 ton.ha^{-1} of vermicompost in the 90 and 120 kg.ha^{-1} nitrogen was obtained (Table 5).

The number of seeds per plant: according to the variance analysis results of nitrogen and vermicompost at one percent probable and their interaction effect at five percent probable had significant effect on the number of seeds per plant (Table 2). According to the mean comparison (Table 3) revealed that in the presence of nitrogen, the number of seeds per plant was increased. The results also (Table 4) show that the use of vermicompost faced with an increase in the number of seeds per plant. Based on the interaction effects between the most the number of seeds per plant in the 15 ton.ha^{-1} vermicompost treatment in the presence of 90 and 120 kg nitrogen per hawas observed (Table 5).

Table 2: The variance analysis results of vermicompost and nitrogen on the rain fed chickpea yield and yield components in Hamadan region.

S.O.V	df	Plant height	number of pods per plant	The number of seeds per plant	Seed hundred weight	Seed yield	Biological yield
Block	2	107.54**	81.29**	54.53**	49.57**	2642.59*	27501.08**
Nitrogen (N)	2	119.15**	91.55**	257.48**	37.55*	10290.63**	14932.37**
Vermicompost (H)	1	369.83**	483.5**	440.85**	122.93**	8117.93**	65808.29**
N*V	2	0.41^{ns}	0.06^{ns}	33.32*	20.52*	1807.63*	1415.62^{ns}
Error	10	8.7	6.52	6.7	5.02	442.52	1199.1
CV%		6.84	10.7	8.38	7.45	7.49	6.14

**, * and ns are significantly at 1%, 5% and not significant, respectively

Table 3: The mean comparisons effect of nitrogen on yield and yield components of rain fed chickpea in Hamadan region.

Nitrogen (kg.ha^{-1})	Plant height(cm)	number of pods per plant	The number of seeds per plant	Seed hundred weight (gr)	Seed yield (gr.m^2)	Biological yield (gr.m^2)
0	38.05^{b}	19.4^{b}	23.44^{b}	27.2^{b}	233.02^{b}	507.69^{b}
90	46.46^{a}	27.5^{a}	33.44^{a}	31.63^{a}	304.73^{a}	581.02^{a}
120	44.79^{a}	26.55^{a}	35.78^{a}	31.44^{a}	304.77^{a}	602.94

Each value is the mean of three replicates. Values followed by different letters in each column are significantly different at P≤5

Table 4: The mean comparisons effect of vermicompost on the rain fed chickpea yield and yield components in Hamadan region.

Vermicompost (ton.ha^{-1})	Plant height(cm)	number of pods per plant	The number of seeds per plant	Seed hundred weight (gr)	Seed yield (gr.m^2)	Biological yield (gr.m^2)
0	38.57^{b}	18.7^{b}	25.94^{b}	27.48^{b}	259.6^{b}	503.42^{b}
15	42.63^{a}	29.06^{a}	35.83^{a}	32.7^{a}	302.07^{a}	624.35^{a}

Each value is the mean of three replicates. Values followed by different letters in each column are significantly different at P≤5

Seed hundred weight: The obtained data from the variance analysis results (Table 2) showed that the vermicompost effect at one percent probable and nitrogen and the interaction effect nitrogen with vermicompost at five percent probable was significant on the seed hundred weight. According to the results by increasing of nitrogen, we observed an increasing in the seed hundred weight (Table 3). Also the results of the mean comparison (Table 4) revealed that by using of vermicompost, the seed hundred weight was increased. The most seed hundred weight (Table 5) in the presence of 15 ton per ha of vermicompost with 90 kg.ha^{-1} of nitrogen was obtained.

Table 5: The mean comparisons effects of vermicompost and nitrogen on the rain fed chickpea yield and yield components in Hamadan region.

Nitrogen ($kg.ha^{-1}$)	Vermicompost ($ton.ha^{-1}$)	Plant height(cm)	number of pods per plant	The number of seeds per plant	Seed hundred weight (gr)	Seed yield ($gr.m^2$)	Biological yield ($gr.m^2$)
0	0	33.8^{c}	14.28^{c}	18.05^{c}	26.56^{c}	231.73^{b}	459.36^{c}
0	15	42.29^{abc}	24.52^{ab}	28.84^{b}	27.85^{bc}	234.3^{b}	556.01^{abc}
90	0	41.7^{abc}	20.4^{bc}	26.38^{b}	27.31^{c}	275.2^{b}	525.69^{bc}
90	15	51.22^{a}	31^{a}	40.49^{a}	35.94^{a}	334.33^{a}	636.36^{ab}
120	0	40.32^{bc}	21.42^{bc}	33.38^{ab}	28.56^{bc}	271.86^{b}	525.21^{bc}
120	15	49.38^{ab}	31.68^{a}	38.18^{a}	34.32^{ab}	337.59^{a}	680.68^{a}

Each value is the mean of three replicates. Values followed by different letters in each column are significantly different at P≤5

Seed yield: Based on the variance analysis results (Table 2) of nitrogen and vermicompost at one percent probable and their interaction effect at five percent probable had significant effect on the seed yield. The results (Table 3) showed that the using of nitrogen and vermicompost was increased seed yield (Table 3 and Table 4). The most seed yield affected by nitrogen and vermicompost (Table 5) from the 15 $ton.ha^{-1}$ vermicompost treatment in the presence of 90 and 120 kg nitrogen per ha was obtained.

Biological yield: based on the variance analysis results (Table 2) of nitrogen and vermicompost at one percent probable had significant effect on biological yield but their interaction effect has no significant effect. The results (Table 3) showed in the presence of nitrogen and vermicompost was increased the biological yield (Table 3 and Table 4). Also the most biological yield affected by nitrogen and vermicompost (Table 5) in the 15 $ton.ha^{-1}$ vermicompost treatment in the presence of120 kg nitrogen per ha was observed.

DISCUSSION

The plant height and plant dry matter increasing by using of nitrogen fertilizer have been reported by some researchers (Mahal and Makota 1998).

The using of nitrogen fertilizer increase photosynthetic rate in leaves and thus increases speed, number of seeds and more pods (Ghosh *et al.*, 1981). Seed weight increasing by using of nitrogen fertilizer probably due to increasing of plant needed nutrients absorption and consequently an increase in photosynthesis process is concerned, the same results by researchers (Hanan *et al.*, 2008, Nasser and El-Gizawy 2009) is obtained.

The researchers observed that the using of organic and biological fertilizers increases plant height. The increasing of vegetative growth is likely due to increasing of organic matter and providing appropriate values of nutrients in the soil and on the other hand improves the water-holding capacity and soil physical properties (Almasiyan *et al.*, 2006). Due to the higher levels of nutrient elements, especially nitrogen in the vermicompost compared to other used compounds and thus stimulates vegetative growth in this treatment was increased. The reason of dry matter increasing at higher levels of vermicompost using is to produce stems and leaf and thus produce drier matter per unit area can be attributed, vermicompost probably due to more availability of nutrient elements, especially nitrogen was increased plant growth (Cortez and Hameed 2001, Jeyabal and Kupposwamy 2001).

Results of other studies indicate that by nutrients increasing in the soil, plant increase its leaf area faster and cause to cover ground of plant top and this has led to rapid growth of product and thus dry matter. On the other hand there are plenty of nutrients in the final stage of growth that leading to an increase in leaves lifetime and leaf durable level which in turn causes the plant to keep photosynthetic level in the longer duration and by receiving more light and longer duration, dry matter production with higher speed and longer duration was maintained (Soumare *et al.*, 2003). Therefore the using of vermicompost keeps chlorophyll and green plant area and increase leaf area durable, aging delay and more light reception. Since plant growth is highly dependent on soil fertility parameters, it seems that physical, chemical and biological characteristics improvement of substrate cultivation by vermicompost (Chanda *et al.*, 2011) is the reason of plant growth and its function in comparing with control treatment. In addition to nutrient elements and organic matter, vermicompost contains large amounts of humic substances that these materials by bioavailability improvement of certain nutrient elements, especially iron and zinc (Chen *et al.*, 2004) and the direct effect on plant metabolism (Nardi *et al.*, 2002) enhances plant growth and yield (Tartoura, 2010).

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