Journal of Crop Nutrition Science
ISSN: 2423-7353 (Print) 2538-2470 (Online)
Vol. 6, No. 1, 2020
http://JCNS.iauahvaz.ac.ir
OPEN ACCESS

Response of Seed yield, Its Components and Chlorophyll Content of Corn to Integrated Effect of Nitrogen Fertilizer and Vermicompost under Different Irrigation Round

Saleh Zohrabi Chanani[1], Saeed Zakernejad*[2]

1- *Msc. Graduated, Department of Agronomy, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.*

2- *Assistant Professor, Department of Agronomy, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.*

RESEARCH ARTICLE

ARTICLE INFO.
Received Date: *29 Dec. 2019*
Received in revised form: *28 Jan. 2020*
Accepted Date: *2 Mar. 2020*
Available online: *30 Mar. 2020*

To Cite This Article:
Saleh Zohrabi Chanani, Saeed Zakernejad. Response of Seed yield, Its Components and Chlorophyll Content of Corn to Integrated Effect of Nitrogen Fertilizer and Vermicompost under Different Irrigation Round. ***J. Crop. Nutr. Sci.,*** 6(1): 20-30, 2020.

ABSTRACT

BACKGROUND: Fertilizer management plays an important role for obtaining satisfactory yields and to increase crop productivity. Improve saving water in irrigated agriculture and thereby improving water use efficiency is of paramount importance in water-scarce regions.

OBJECTIVES: This study was conducted to assessment effect of different levels of irrigation regime, nitrogen fertilizer and vermicompost and on seed yield, its components and chlorophyll traits of corn.

METHODS: This research was carried out to via split plot experiment based on randomized complete blocks design with three replications along 2015 year. The main factor included three level of irrigation regime (Ir_1: 60mm evaporation Pan Class A, Ir_1: 90mm evaporation Pan Class A, Ir_1: 120mm evaporation Pan Class A) and sub factor consisted three level of fertilizer (N_1: 100% Urea fertilizer, N_2: 50% urea fertilizer + 50% vermicompost, N_3: 100% vermicompost).

RESULT: Result of analysis of variance indicated effect of irrigation regime and nutrition on all studied traits (instead harvest index) was significant, but interaction effect of treatments was not significant. Mean comparison result of different level of irrigation regime revealed that maximum amount of studied traits was noted for Ir_1 and minimum of those belonged to Ir_3 treatment. Also as for Duncan classification made with respect to different level of nutrition maximum and minimum amount of studied traits belonged to N_2 and N_1 treatment.

CONCLUSION: Finally according result of current research Ir_1 treatment (60mm evaporation Pan Class A) with apply N_2 treatment (50% urea fertilizer + 50% vermicompost) had the highest amount of studied traits and it can be advice to producers in studied region.

KEYWORDS: *Biofertilizer, Crop production, Maize, Morphology, Urea*.

***Corresponding Author:** Saeed Zakernejad ✉ Zakernezhad48@yahoo.com

1. BACKGROUND

The nutrient management may be achieved by the involvement of the organic sources, biofertilizers, and micronutrients (Singh *et al*., 2002). Indiscriminate use of the chemical fertilizers to achieve high yield and to compensate for lack of nutrients and consequently the increase of production costs and destruction of soil and water resources have made the specialists interested in healthy and stable crop systems in terms of ecology (Tilak *et al*., 1992). Studies have shown that long-term use of fertilizers reduces crop yields. This decrease is due to the acidification of the soil, the reduction of biological activity of the soil and the inappropriate physical properties of the soil (Alexandratos, 2003). To alleviate the problem, integrated plant nutrient management is an option as it utilizes available organic and inorganic nutrients to build ecologically sound and economically viable farming system. Research has suggested that integrated nutrient management strategies involving chemical fertilizers and bio-fertilizers enhance the sustainability of crop production. Integrated plant nutrient management is the combined use of mineral fertilizers with organic resources such as cattle manures, crop residues, urban/rural wastes, composts, green manures and bio-fertilizers (Kemal and Abera, 2015). Jafari Haghighi and Yarmahmodi (2011) in conclusion for reach to high yield in corn stated biological fertilizer cannot sufficient but integrated application of fertilizers (Biological and chemical fertilizers) became causes significant increase in yield. Vermicomposts are finely-divided mature peat-like materials with a high porosity, aeration, drainage and water-holding capacity and microbial activity which are stabilized by interactions between earthworms and microorganisms in a non-thermophilic process (Edwards and Burrows, 1988). Vermicompost has many characteristics such as high porosity, ventilation and proper drainage, high moisture absorption and maintenance power, high uptake level for water and food stuffs, and its use in sustainable agriculture is very useful to improve soil porosity and thus more availability of nutrient elements required by plants. So 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). Suhane *et al*. (2008) reported use of only 2.5 $t.ha^{-1}$ vermicompost wheat farm has a better result compared to use chemical fertilizers. Vermicompost could also reduce plant's water requirement by about 30 to 40%. The use of vermicompost increases protein yield, probably this increase is due to the relatively higher amounts of nutrients and increased grain yield (Jat and Ahlawat, 2008). The use of vermicompost has positive effects on 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 and Ahlawat, 2008). One of limitation factor in agricultural plants production in dry areas in the water tension at growth step negative effect of water tension on corn growth depends on the time of tension occurrence, the intensity, plant growth and genotype step. Low irrigation is strategies to expert agricultural plant tillage and scrounge in water use which is a proper method to produce harvest in water shortage, generally in this method water performance is reduced cognizant to be compensated by enter tillage surface expansion and in many areas of many countries have water shortage, this method is prevalent (English and James, 1990). According limitation of water in arid and semi-arid areas some people do not obey the irrigation water consumption rules and regulations (Cakir, 2004).

2. OBJECTIVES

This study was conducted to assessment effect of different levels of irrigation regime, nitrogen fertilizer and vermicompost and on seed yield, its components and chlorophyll traits of corn.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was carried out to via split plot experiment based on randomized complete blocks design with three replications along 2015 year. Place of research was located in Ahvaz city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). The main factor included three level of irrigation regime (Ir_1: 60mm evaporation Pan Class A, Ir_1: 90mm evaporation Pan Class A, Ir_1: 120mm evaporation Pan Class A) and sub factor consisted three level of fertilizer (N_1: 100% Urea fertilizer, N_2: 50% urea fertilizer + 50% vermicompost, N_3: 100% vermicompost). The physical and chemical properties of the studied soil are mentioned in table 1.

Table 1. Physical and chemical properties of the studied field

Soil depth (cm)	Absorbable elements (%)	(ppm)		Percentage of soil components			Soil type	pH
	N	P	K	Clay	Loam	Sand		
0-30	0.50	7.20	130.12	27	38	35	Clay loam	7.8
30-60	0.20	8.10	132.11	35	28	37	Clay loam	8.1

3.2. Farm Management

Each sub plot included the 6 planting lines with a length of 5 m. The distance between row and seed on the row were 75 and 18 cm respectively. Irrigation was done according treatments at every 3 or 4 days and after the plant establishment it was done every 7 to 10 days if necessary. The weeds were controlled via Cruise herbicide by 2 $L.ha^{-1}$ at 4-to-5-leaf stage and Krakrown pesticide by 1 $L.ha^{-1}$ against leaf and larvae.

3.3. Measured Traits

The final harvest area of each plot was 1.5 m^2. Seed yield, its components and qualitative traits were estimated after the physiological maturity. After separating seed from selected plants and weighing them, seed yield was calculated based on 14% moisture. In order to estimate 100 seed weigh, 10 samples of seed containing 10 seed were separated and the means was calculated. The final harvesting area was equal to 4.8 m-2 that was done from two middle lines of planting. Corn seed yields were determined by hand harvesting the 8 m sections of three center rows in each plot. Then, seed yield values were adjusted to 15.5% moisture content. In addition, the 1000-seed weight, number of row per ear, number of seed per row and number of seed per ear were measured separately from the final harvest plants per plot values were also evaluated. Harvest index (HI) was calculated according to formula of Gardner *et al*. (1985) as follows: **Equ.1.** HI= (Seed yield/Biologic yield) ×100.

Chlorophyll content of five ear leaves in each plot was measured at anthesis stage by SPAD 502 device, accurately three points of leaf measured and average of three numbers was considered. (SPAD 502, Minolta Company, Japan).

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via SAS (Ver.8) software and Duncan multiple range test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. Seed yield

Yield is a complex trait resulting from interaction of morphological, physiological and environmental parameters on the growth of plants. Identification of the variations of morphological and physiological traits influencing the yield of a plant in a certain environment is an essential tool for selecting and breeding of yield (Azarpour *et al*., 2014). According result of analysis of variance effect of irrigation regime and nutrition on seed yield was significant at 1% and 5% probability level, respectively but interaction effect of treatments was not significant (Table 2). Mean comparison result of different level of irrigation regime indicated that maximum seed yield (7347.16 $kg.ha^{-1}$) was noted for Ir_1 and minimum of that (4315.40 $kg.ha^{-1}$) belonged to Ir_3 treatment (Table 3). As for Duncan classification made with respect to different level of nutrition maximum and minimum amount of seed yield belonged to N_2 (6963.05 $kg.ha^{-1}$) and N_1 treatment (5318.38 $kg.ha^{-1}$) (Table 4). Karimi (2007) stated that their use of organic fertilizers and chemical fertilizers has a greater effect than alone use of them on corn yield. Using vermicompost, the physical and chemical properties of the soil have improved, resulting in more root development, reducing water losses, and conditions for improved growth and photosynthesis, and thus the plant will be able to produce more biomass and biological yield (Sainz *et al.,* 1998). Singh *et al*. (2009) reported that vermicompost increased chickpea yield. Seghatoleslami (2013) on cumin also reported that manure application increases cumin yield. Application of inorganic fertilizers along with biofertilizer significantly increased maize yield (Abou El-Magd *et al.,* 2006).

Table 2. Result analysis of variance of studied traits

S.O.V	df	Seed yield	Biologic yield	No. row per ear	No. seed per ear
Replication	2	23641.8	339704.2	8.646	12.214
Irrigation round (Ir)	2	93557.8**	316354.30**	39.573**	218.716*
Error I	4	4453.31	13815.5	2.117	17.837
Nutrition (N)	2	18264.5*	89572.18*	5.560*	28.116*
Ir×N	4	12.25ns	1.38ns	0.147ns	0.402ns
Error II	12	2840.74	16863.31	11.096	4.723
CV (%)	-	8.83	8.45	6.93	0.45

ns, * and **: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 2.

S.O.V	df	No. seed per row	1000-seed weight	Harvest index	Chlorophyll index
Replication	2	3.881	33.080	3.17	15.88
Irrigation round (Ir)	2	27.662*	76.080*	112.61*	242.55**
Error I	4	3.285	6.175	9.70	12.73
Nutrition (N)	2	15.752**	32.479**	13.85ns	23.779*
Ir×N	4	0.673ns	0.744ns	0.36ns	0.69ns
Error II	12	2.235	3.621	6.52	3.77
CV (%)	-	4.62	0.91	2.52	4.58

ns, * and **: no significant, significant at 5% and 1% of probability level, respectively.

4.2. Biologic yield

Result of analysis of variance revealed effect of irrigation regime and nutrition on biologic yield was significant at 1% and 5% probability level, respectively but interaction effect of treatments was not significant (Table 2). According result of mean comparison maximum of biologic yield (18550.54 kg.ha^{-1}) was obtained for Ir_1 and minimum of that (11058.20 kg.ha^{-1}) was for Ir_3 treatment (Table 3). Evaluation mean comparison result indicated in different level of nutrition the maximum amount of biologic yield (17637.56 kg.ha^{-1}) was noted for N_2 and minimum of that (13557.91 kg.ha^{-1}) belonged to N_1 treatment (Table 4). Edwards and Bates (1992) found that earthworms increased significantly the number, growth rate, and yield of plants growing on inoculated sites. Manure application improves the soil structure and soil moisture content, provides plant with essential elements, increases growth, number of umbrella per plant and biological yield and finally led to increase seed yield (Ahmadian *et al.,* 2011). Several studies have investigated the positive effect of vermicompost on increasing the quantitative and qualitative performance of crops and medicinal plants, including the effect of vermicompost on biological yield, basil, chamomile, forage corn, forage forage, forage sorghum, artemisia and Joe pointed out (Haj Seyed Hadi *et al.,* 2010).

4.3. Number of row per ear

According result of analysis of variance effect of irrigation regime and nutrition on number of row per ear was significant at 1% and 5% probability level, respectively but interaction effect of treatments was not significant (Table 2). Assessment mean comparison result indicated in different level of irrigation regime the maximum number of row per ear (15.85) was noted for Ir_1 and minimum of that (13.32) belonged to Ir_3 treatment (Table 3). Mohammadi *et al.* (2011) reported providing enough moisture two weeks before and after pollination is a critical period in corn farming. If the drought stress occurs before pollination and during the florlet production stage, the number of florets per ear decreased, even in acceptable pollination, the number of seed per row and ear will be significantly reduced. If pollination occurs during drought stress, many pollen seeds will become infertile and ineffective. Drought stress at the pollination stage causes pollen is abort and consequently the number of seeds decreases. Drought stress after pollination in the seed filling period led to decrease seed weight. Compare different level of nutrition showed that the maximum and the minimum amount of number of row per ear belonged to N_2 (118.3) and N_1 (92.52) treatments (Table 4).

Table 3. Mean comparison effect of different level of irrigation on studied traits

Treatment	Seed yield (kg.ha^{-1})	Biologic yield (kg.ha^{-1})	No. row per ear	No. seed per ear
Ir_1	7347.16^{a}	18550.54^{a}	15.85^{a}	556.37^{a}
Ir_2	6443.51^{ab}	16468.40^{ab}	15.37^{a}	494.80^{ab}
Ir_3	4315.40^{b}	11058.20^{b}	13.32^{b}	381.63^{b}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.
Ir_1: 60mm evaporation Pan Class A, Ir_1: 90mm evaporation Pan Class A, Ir_1: 120mm evaporation Pan Class A.

Continue Table 3.

Treatment	No. seed per row	1000-seed weight (gr)	Harvest index (%)	Chlorophyll index
Ir_1	35.03^{a}	219.73^{a}	39.60^{a}	47.50^{a}
Ir_2	32.71^{ab}	212.64^{ab}	39.12^{b}	42.1^{b}
Ir_3	28.59^{b}	187.90^{b}	39.02^{b}	36.40^{c}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.
Ir_1: 60mm evaporation Pan Class A, Ir_1: 90mm evaporation Pan Class A, Ir_1: 120mm evaporation Pan Class A.

4.4. Number of seed per ear

Result of analysis of variance indicated effect of irrigation regime and nutrition on number of seed per ear was significant at 5% probability level, but interaction effect of treatments was not significant (Table 2). Assessment mean comparison result indicated in different level of irrigation regime the maximum number of seed per ear (556.37) was noted for Ir_1 and minimum of that (381.63) belonged to Ir_3 treatment (Table 3). Compare different level of nutrition showed that the maximum and the minimum amount of number of seed per ear belonged to N_2 (537.35) and (435.68) N_1 treatments (Table 4). Sadeghipour and Aghaei (2014) reported an increase in the number of seeds per pods under non-stress conditions than to stress situation was 25.64%. That matter was related to more photosynthesis and greater transfer of photosynthetic material to the seeds.

Table 4. Mean comparison effect of different level of nitrogen on studied traits

Treatment	Seed yield ($kg.ha^{-1}$)	Biologic yield ($kg.ha^{-1}$)	No. row per ear	No. seed per ear
N_1	5318.38^{b}	13557.91^{b}	14.41^{b}	435.68^{b}
N_2	6963.05^{a}	17637.56^{a}	15.40^{a}	537.35^{a}
N_3	5824.65^{ab}	14881.67^{ab}	14.74^{b}	468.78^{ab}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.
N_1: 100% Urea fertilizer, N_2: 50% urea fertilizer + 50% vermicompost, N_3: 100% vermicompost.

Continue Table 4.

Treatment	No. seed per row	1000-seed weight (gr)	Harvest index (%)	Chlorophyll index
N_1	30.03^{b}	201.18^{b}	39.22^{a}	37.90^{b}
N_2	34.67^{a}	214.06^{a}	39.47^{a}	47.50^{a}
N_3	31.63^{b}	205.04^{ab}	39.13^{a}	40.60^{ab}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.
N_1: 100% Urea fertilizer, N_2: 50% urea fertilizer + 50% vermicompost, N_3: 100% vermicompost.

4.5. Number of seed per row

According result of analysis of variance effect of irrigation regime and nutrition on number of seed per row was significant at 5% and 1% probability level, respectively but interaction effect of treatments was not significant (Table 2). Evaluation mean comparison result revealed in different level of irrigation regime the maximum number of seed per row (35.03) was noted for Ir_1 and minimum of that (28.59) belonged to Ir_3 treatment (Table 3). Between different levels of nutrition the maximum number of seed per row (34.67) was observed in N_2 and the lowest one (30.03) was found in N_1 treatment (Table 4). Jahangiri Nia *et al*. (2016) reported that the application of vermicompost fertilizer in addition to supplying a large portion of plant nutrients was also involved in moderating the negative effects of water stress and by reducing these negative effects led to improve number of seeds per pod in stress situation. Monneveux *et al*. (2006) reported that number of seeds per row affected more reducing yielded in compared with drought stress. Drought stress in flowering stage delayed tassels emergence. So tassels emerge when the pollination has done and no longer pollen has exists or reduced. Hence, no ovule, have fertilized and consequently no grain forms and this resulted in few grains formation at whole ear (Zenselmeier *et al.,* 1998).

4.6. 1000-seed weight

Result of analysis of variance indicated effect of irrigation regime and nutrition on 1000-seed weight was significant at 5% and 1% probability level, respectively but interaction effect of treatments was not significant (Table 2). Mean comparison result of different level of irrigation regime indicated the maximum and the minimum amount of 1000-seed weight belonged to Ir_1 (219.73 gr) and Ir_3 treatment (187.90 gr) (Table 3). Reducing seed weight in drought stress due to the premature aging of leaves and, consequently, reducing the seed filling period. There is a significant correlation between water potential and stored assimilate of it, so increasing the water potential of seed led to increase the develope of the cells and improve sink power (Larbi and Mekliche, 2004). Among different level of nutrition maximum 1000-seed weight pod (214.06 gr) was obtained for N_2 and minimum of that (201.18 gr) was for N_1 treatment (Table 4). The increase amount of nutrients available by use chemical and bio fertilizers has largely lead to increasing seed weight (Hassanpour *et al*., 2011).

4.7. Harvest index

Harvest index shows the way of dividing the nutritional materials between growing structures of grain and plant. As one of the components for calculating the HI is grain yield, the changes in HI depend very much on the changes of grain yield. Based on the formula of HI, every factor can change the harvest index when the grain yield is influenced more than total dry weight (Sinclair *et al*., 1990). According result of analysis of variance effect of irrigation regime on number of harvest index significant at 5% probability level, but effect of nutrition and interaction effect of treatments was not significant (Table 2). Mean comparison result of different level of irrigation regime indicated maximum harvest index (39.60 gr) was for Ir_1 and minimum of that (39.02 gr) was for Ir_3 treatment (Table 3).

4.8. Chlorophyll index

Result of analysis of variance revealed effect of irrigation regime and nutrition on chlorophyll index was significant at 1% and 5% probability level, respectively but interaction effect of treatments was not significant (Table 2). According mean comparison result of different level of irrigation regime the maximum chlorophyll index (47.50) was observed in Ir_1 and the lowest one (36.40) was found in Ir_3 treatments (Table 3). Chlorophyll is one of the major indexes indicating the environmental pressures on the plants. In plants, the value (amount) of chlorophyll descends under the stress of moisture and reduction of N_2 reduces the light absorption. Albert and Thornber (1977) have investigated the effects of water deficit stress on the content and order of Mesophilic chlorophylls and vascular pod in corn leaves and stated amount of leaf's chlorophyll reduces as a result of water deficit stress and this reduction is due to the lack between chlorophyll's lamla. Between different levels of nutrition highest value of chlorophyll index was belonged to the N_2 treatment (47.50) and the lowest one was found in the N_1 treatment as 37.90 (Table 4). Amanolahi baharvand *et al*. (2014) reported integrated fertilizer (50% urea and 50% vermicompost) management improved corn growth, chlorophyll and remobilization in corn plants. Soleimanzadeh and Ghooshchi (2013) reported biofertilizer had significantly effects on leaf chlorophyll, because inoculation with mycorrhiza increased leaf chlorophyll (2.66 $mg.g^{-1}$ FW).

5. CONCLUSION

Finally Ir_1 treatment (60mm evaporation Pan Class A) with apply N_2 treatment (50% urea fertilizer + 50% vermicompost) had the highest amount of studied traits and it can be advice to the producers in studied region.

ACKNOWLEDGMENT

The authors thank all colleagues and other participants, who took part in the study.

FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

CONFLICT OF INTEREST: Authors declared no conflict of interest.

FUNDING/SUPPORT: This study was done by support of Department of Agronomy, Islamic Azad University, Ahvaz Branch.

REFRENCES

Abou El-Magd, M. M., A. M. El-Bassiony. and Z. F. Fawzy. 2006. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. J. Appl. Sci. Res. 2(10): 791-798.

Ahmadian, A., A. Ghanbari, M. Siahsar Haydari, M. Ramroodi. and S. M. Mousavinik. 2011. Study of chamomile's yield and its components under drought stress and organic and inorganic fertilizer using and their residue. J. Microbiol. Anti Micro. 3(2): 23-28.

Albert, R. S. and J. P. Thornber. 1977. Water stress effects on content and organization of chlorophyll in mesophyll and chloroplasts of maize. Plant Physiol. J. 59: 351-353.

Alexandratos, N. 2003. World agriculture: Towards 2015-30. Cong. Global food security and role of sustainable fertilizer. Rome. Italy.

Amanolahi baharvand, Z., H. Zahedi. and M. Rafiee. 2014. Effect of Vermicompost and Chemical Fertilizers on Growth Parameters of three Corn Cultivars. J. Appl. Sci. Agric. 9(9): 22-26.

Azarpour, E., M. Moraditochaee. and H. R. Bozorgi. 2014. Effect of nitrogen fertilizer management on growth analysis of rice cultivars. Intl. J. Bio-Sci. 4(5): 35-47.

Cakir, R. 2004. Effect of water stress at different development stages on vegetative and reproductive growth of corn. Field Crops. J. 89: 1-16.

Claudio, P. J., B. Raphael, F. Alves, L. R. Kamiila, S. N. Brunade. and M. Priscila. 2009. Zn (II) adsorption from synthetic solution and kaolin wastewater on vermicompost. Sci. Total Environ. 162: 804-811.

Edwards, C. A. and I. Burrows. 1988. The potential of earthworm composts as plant growth media. pp: 211-220. *In*: Earthworms in environmental and waste management. C. A. Edwards and Neuhauser. (Eds.). SPB Academic Publ. Netherlands.

Edwards, C. A. and J. E. Bates. 1992. The use of earthworms in environmental management. Soil Bio and Biochemist. J. 14(12): 1683-1689.

English, M. J. and L. James. 1990. Deficit irrigation. II: Observation on colombia basin. ASCE, J. Irrigation Drain. Eng. 116: 413-426.

Gardner, F. P., R. B. Pearce. and R. L. Mitchell. 1985. Physiology of crop plants. Ames, IA: Iowa State Univ. Press. USA. 121 pp.

Haj Seyed Hadi, M., M. T. Darzi. and Z. Ghandahari Al-Wajah. 2010. Effect of spraying with amino acids and application of different amounts of vermicompost on morphological and chamomile flowers. New Agri. Findings. J. 5(2): 158-147.

Hassanpour, R., H. Pyrdshty, M. Ismaili. and A. Abbasids. 2011. Effects of nitrogen biological fertilizer on yield and yield components of sesame varieties. Proc. 11th Cong. Agron. Plant Breed. 4th August. Iran. pp: 4217-4220. (Abstract in English)

Jafari Haghighi, B. and Z. Yarmahmodi. 2011. Evaluation effects of biological fertilizer on physiological characteristic on yield and its components of corn (*Zea mays* L) under drought stress. Int. Conf. Food Eng. Biotech. IACSIT Press. Singapore. pp: 1-5.

Jahangiri Nia, E., S. A. Siyadat, A. Koochakzadeh, M. R. Moradi Telavat. and M. Sayyah Far. 2016. Effect of the usage of vermicompost and mycorrhizal fertilizer on quantity and quality yield of soybean in water deficit stress condition. J. Crops Improv. 18(2): 319-331.

Jat, R. S. and I. P. S. Ahlawat. 2008. Direct and residual effect of vermicompost, biofertilizers and phosphorus on soil nutrient dynamics and productivity of chickpea-fodder maize sequence. J. Sust. Agri. 28(1): 41-54.

Karimi, E. 2007. Forage crops and breeding and cultivation. Tehran Univ. Press. 428 p.

Kemal, Y. O. and M. Abera. 2015. Contribution of integrated nutrient management practice for sustainable crop productivity, nutrient uptake and soil nutrient status in Maize based cropping systems. J. Nutr. 2(1): 1-10.

Larbi, A. and A. Mekliche. 2004. Relative water content (RWC) and leaf senescence as screening tools for drought tolerance in wheat. Options

Mediterranean's Series A, Seminaries Mediterranean's. 60: 193–196.

Mohammadi, Y. 2011. Evaluation effect of different amounts of water consumption and planting arrangement on seed yield of corn at Khuzestan province. Msc. Thesis. Faculty of Agriculture. Chamran Univ. 117 pp. (Abstract in English)

Monneveux, P., C. Sanchez, D. Beck. and G. O. Edmeds. 2006. Drought tolerance improvement in topical maize source populations: evidence of progress. Crop Sci. J. 46: 180-191.

Sadeghipour, O. and P. Aghaei. 2014. Investigation the effect of drought stress and magnetized water on yield and yield components of mung bean. J. Crop Prod. Res. 6(1): 79-87. (Abstract in English)

Sainz, M. J., M. T. Taboada-Castro. and A. Vilarino. 1998. Growth, mineral nutrition and mycorrhizal colonization of red clover and cucumber plants grown in a soil amended with composted urban wastes. Plant Soil. J. 205: 85-92.

Seghatoleslami, M. 2013. Effect of water stress, bio-fertilizer and manure on seed and essential oil yield and some morphological traits of cumin. Bulgarian. J. Agri. Sci. 19(6): 1268-1274.

Sinclair, T., R. D. M. Bennetto. and R. O. Muchow. 1990. Relative sensitivity of grain yield and biomass accumulation to drought in field grown maize. Crop Science. J. 30: 690- 693.

Singh, D. K., A. K. Pandey, U. B. Pandey. and S. R. Bhonde. 2002. Effect of farmyard manure combined with foliar application of NPK mixture and micronutrients on growth, yield and quality of onion. Newsletter-National Horti. Res. Develop. Found. 21-22: 1-7.

Singh, N. I. and J. S. Chauhan. 2009. Response of French bean (*Phaseolus vulgaris* L.) to organic manures and inorganic fertilizer on growth and yield parameters under irrigated condition. Nature Sci. J. 7: 52-54.

Soleimanzadeh, H. and F. Ghooshchi. 2013. Response of growth and yield of maize to bio-fertilizers in organic and conventional cropping systems. Intl. J. Agri. Crop Sci. 5 (7): 797-801.

Suhane, R. K., R. K. Sinha. and P. K. Singh. 2008. Vermicompost, cattle-dung compost and chemical fertilizers: Impacts on yield of wheat crops. Commun. Rajendra Agri. Univ. Pusa. Bihar. India.

Tilak, K. V. B. R., C. S. Singh, N. K. Roy. and N. S. Subba Rao. 1992. Azospirillum brasilense and Azotobacter chrococcum inoculum effect on maize and sorghum. Soil Biol. Biochem. J. 14: 417-418.

Zenselmeier, C., M. E. Westgate. and R. J. Jones. 1998. Kernel set at low water potential does not vary with source sink ratio in maize. Crop Sci. J. 35: 158-163.