

Evaluation the Effects of Biological Fertilizer on Physiological Characteristic on Yield and Its Components of Corn (*Zea mays L.*) Under Drought Stress

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Abstract. This experiment was carried out in 2008 at experimental field of Arsanjan Islamic Azad university for study the effects of chemical and biological fertilizers and interaction between them on some physiological characteristic and yield and its components of seed corn in two different irrigation. The experiment was conducted in a split plot factorial with completely randomized block design using four replications. Sub plots consisted of combined application levels N-fertilizer with two level (0 and 300 kg.ha⁻¹) Urea and two level of biological fertilizer (0 and 4 Lit/ha⁻¹) in four stage that was from 4th leaf appearance until milk stage. Biological fertilizer was combined of Kadostim, Phosphotern, Aminolephorte and Hyomiphorte. Main plots consisted of two period of irrigation (8 and 12 days). The results showed that highest grain yield was in conditional application at integrated treatment 300 kg.ha⁻¹ Urea fertilizer and 4 Lit.ha⁻¹ biological fertilizer (12.5 ton.ha⁻¹) that with compared to control treatment showed increase 257%. In this treatment decrease irrigation (12 days period of irrigation) from pollination stage to seed maturity, decreased 8.9% in yield. The highest kernel number per ear and highest 1000 kernel weight was in integrated fertilizer treatment but in 8 days period of irrigation was not significant difference between integrated treatment and chemical treatment for 1000 kernel weight. The integrated treatment in 8 days period of irrigation showed the highest CGR, NAR and LAI (14.2gr.m⁻².day⁻¹, 2.9gr.m⁻².LA.day⁻¹ and 5.1) respectively. And decrease 12 days period of irrigation had little effect on CGR and NAR but application of chemical fertilizer after decrease irrigation CGR had much reduce trend to compared integrated treatment. In conclusion for reach to high yield in corn biological fertilizer can not sufficient but integrated application of fertilizers (Biological and Chemical fertilizers) became causes significant increase in yield.

Key words: fertilizer, yield and yield components, CGR, NAR, LAI.

1. Introduction

Organic agriculture is one of the ways that can produce high quality crops (Higa, 1994). Most of the studies, in this area have been shown that consecutive uses of chemical fertilizer causes soil erosion and lower crops quality (Kumar *et al.*, 2001). In addition to soil application, nutritional elements can be used as foliar application. Nutritional spray on plants can decrease the delay between absorption and consumption of elements by plant, that is very important for fast growth stage of plant (Taize and Zeiger, 2002). Obviously, combined application of organic fertilizer and urea fertilizer or combination urea fertilizer and polyamines significantly increased yield, vegetative growth and chlorophyll index (Zeid, 2008). Also in Iran, Majidian *et al.*(2006) showed that integrated chemical and biological fertilizer increase yield under drought stress. Sivasubramaniawn (1992) related the drought resistance of plants to the chlorophyll stability index that has been employed to determine the thermostability of chlorophyll. This study was therefore designed to investigate the effects of applications of biological fertilizer and chemical fertilizer on leaf area index, crop growth rate (CGR), net assimilation rate (NAR) and yield of corn under drought stress.

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2. Materials and Methods

The experiment was conducted in 2008 at experimental farm of Arsanjan Islamic Azad university (53° 16' N, 50° 29' E). The soil texture was sandy loam and result soil analysis is shown in table (1) :

Table (1): Soil properties of experimental field

Deep of soil (cm)	EC (ds.m ⁻¹)	PH	Organic matter (%)	N ppm	P ppm	K ppm
0-30	0.58	7.8	1	320	5.7	150
30-60	0.76	7.6	0.75	230	4.6	135.5

Treatment consisted of two level drought stress: one without stress (8 days period of irrigation) and the other drought stress (12 days period of irrigation) that used after pollination and there were four fertilizer treatments: (1) no fertilizer (control). (2) organic fertilizer (4 Lit.ha⁻¹ from source of Kadostim-PhosPhotern-Aminolephorte and Hiomiphorte) which applied in vegetative, flowering and milk stages. (3) chemical fertilizer (300kg.ha⁻¹ from source of Urea fertilizer) which applied pre sowing, 6th leaf appearance and pre flowering. (4) utilization of both biological and chemical fertilizers. The experiment was conducted in a split plot with completely randomized block design using four replications. The test crop were corn (*Zea mays* L. var. *Maxima*). Each experimental plot was 16m² including five planting row with 3m length and with distancing 0.6m and each plant was 20cm a per. Plants were harvested at maturity for yield and yield components and leaf area index and dry matter were measured at both of vegetative and reproduction stages each 15 days for calculating crop growth rate (CGR),net assimilation rate (NAR) and leaf area index (LAI). (1) LAI=LA/SA (2) CGR=W₂-W₁/t₂-t₁

LA is leaf area, SA is ground area that occupied a plant, W is dry matter and t is day after planting. Data were subjected to analysis of variance (ANOVA) and the treatment means were compared using Duncan multiple range test.

3. Resultes and Discussion

3.1. Grain yield

The result showed that, the highest grain yield was in conditional application integrated treatment 300 kg.ha⁻¹ Urea fertilizer and 4 Lit.ha⁻¹ biological fertilizer (12.5 ton.ha⁻¹) that compared to control treatment showed increase 257%. Application integrated chemical fertilizer with biological fertilizer caused to be produce highest yield compared with application chemical and biological treatment alone (Rizwan, 2008). In this treatment, drought stress (12 days period of irrigation) decreased 8.9% in yield (table 2). Drought stress is a major abiotic constraint responsible for heavy production losses (Khan *et al.*, 2007). Application 300 kg.ha⁻¹ urea fertilizer, obtained highest yield (11.36 ton.ha⁻¹) compared with control treatment showed increase 110% in yield and this treatment drought stress decrease 13.7% in yield but application 4 Lit.ha⁻¹ biological fertilizer compared with control treatment increased 43.5% (table 2). Organic and inorganic fertilizers applied to the soil affect the plant physiological processes, which serve as important instruments in yield development.

Table2:Interaction between chemical and biological fertilizer in 8 and 12 days period of irrigation on the yield (ton.ha-1) in corn (var. Maxima)

Utilization of both Bio. And Chem. fertilizer	Chemical fertilizer	Biological fertilizer	Control	Treatment
12.5 a	11.36 b	7.4 c	3.5 d	8 days period of irrigation
11.4 a	9.4 b	6.9 c	2.9 d	12 days period of irrigation

3.2. kernel number per ear

The highest kernel number per ear, obtained at integrated treatment 300 kg.ha⁻¹ urea fertilizer and 4Lit.ha⁻¹ (550 number) in this treatment drought stress decreased 1.9% in kernel number per ear (table 3). Although application one of the chemical and biological fertilizer treatments can not produce kernel number per ear more than integrated treatment. In 300 kg.ha⁻¹urea fertilizer treatment, kernel number per ear was (520 number) and in biological fertilizer treatment was (477 number) (table 3). Majidian *et al.* (2006) showed that integrated chemical and biological fertilizer obtained highest kernel number per ear compared with sole application of them.

Table 3 : Interaction between chemical and biological fertilizer in 8 and 12 days period of irrigation on the kernel number per ear in corn (var. Maxima)

Utilization of both Bio. And Chem. fertilizer	Chemical fertilizer	Biological fertilizer	Control	Treatment
550 b	520 b	477 c	249 d	8 days period of irrigation
546 a	495 b	379 c	219 d	12 days period of irrigation

3.3. 1000 kernel weight

The highest 1000 kernel weight was in integrated chemical and biological treatment (300 gr) but in 8 days period of irrigation there was no significant difference between integrated treatment and chemical treatment (286 gr) (table 4). Ibeawuchi and Onweremalu (2007) in an experiment showed that, at first of all the highest 1000 kernel weight was in integrated fertilizer treatments and the following was in chemical fertilizer. The application of 300 kg.ha⁻¹ urea fertilizer, produced 1000 kernel weight with (286 gr) compared with control treatment increased 27.7% on that but in this treatment drought stress decreased 3.1% 1000 kernel weight (table 4).

Table 4 : Interaction between chemical and biological fertilizer in 8 and 12 days period of irrigation on the 1000 kernel weight (gr) in corn (var. Maxima)

Utilization of both Bio. And Chem. fertilizer	Chemical fertilizer	Biological fertilizer	Control	treatment
300 a	286 a	243 b	200 c	8 days period of irrigation
287 a	275 b	237.5 c	187.5 d	12 days period of irrigation

3.4. Leaf Area index

Leaf area index with the use of 300 kg.ha⁻¹ urea fertilizer in 8 days period of irrigation was (4.3) in which drought stress in this treatment decreased 22.9% in LAI (table 5). Application biological fertilizer treatment alone in 8 and 12 days period of irrigation observed that drought stress in this treatment there was no significant difference on the LAI, this result showed that biological fertilizer to obtain relative resistance opposes the drought stress (table 5). The highest LAI was in integrated treatment in 8 days period of irrigation (5.1) and drought stress in this treatment decreased 11% in LAI. In this study there was a significant correlation between LAI and yield ($r = 0.91^{**}$) furthermore the regression between LAI and yield ($y = 0.7967x^2 - 2.884x + 7.3$) showed that increase in LAI, will result to yield increase (fig.1).

Table 5 : Interaction between chemical and biological fertilizer in 8 and 12 days period of irrigation on the leaf area index in corn (var. Maxima)

Utilization of both Bio. And Chem. fertilizer	Chemical fertilizer	Biological fertilizer	Control	Treatment
5.1 a	4.3 b	3.3 c	2.4 d	8 days period of irrigation
4.76 a	3.5 b	3.1 c	2.2 d	12 days period of irrigation

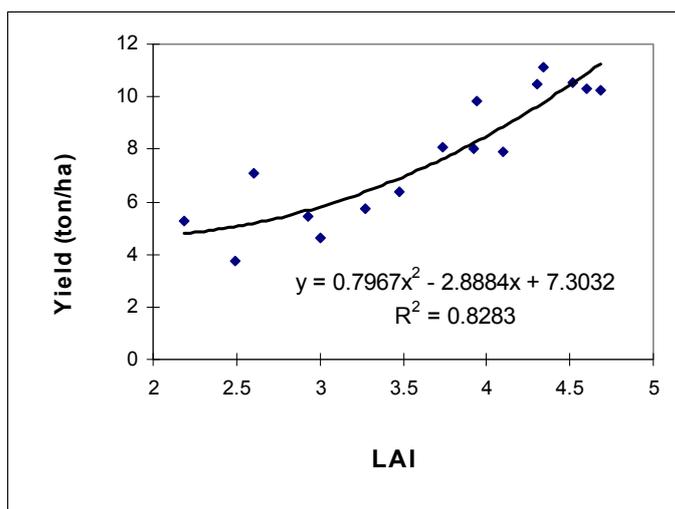


Fig. 1: Relationship between leaf area index and grain yield in corn (var. Maxima) in two difference irrigation

3.5. Crop Growth rate (CGR)

Crop growth rate in integrated 300 kg.ha⁻¹ urea and 4 lit.ha⁻¹ biological fertilizer (14.2 gr/m²/day) during the experiment was increased compared with other treatment (fig. 2). Probably in this experiment some of the many differences at crop growth rate is related to leaf area index, for this reason that crop growth rate changes is depended to two parameters: namely leaf area index and net assimilation rate. This result was verified by Brongeham in newzeland (2000). Application 300 kg.ha⁻¹ urea fertilizer sole produced CGR (12.72 gr/m²/day) (fig. 3) and application 4 lit.ha⁻¹ biological fertilizer produced CGR (9.1gr/m²/day) (fig.4). Drought stress in tassel stage in chemical fertilizer treatment caused more decrease CGR compared with biological fertilizer (fig.3 and fig.4).

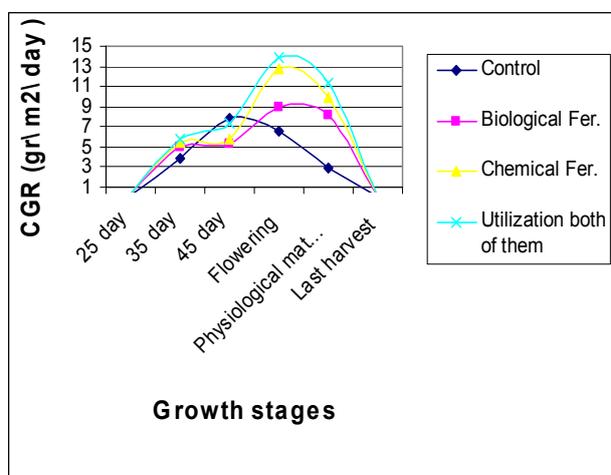


Fig. (2)

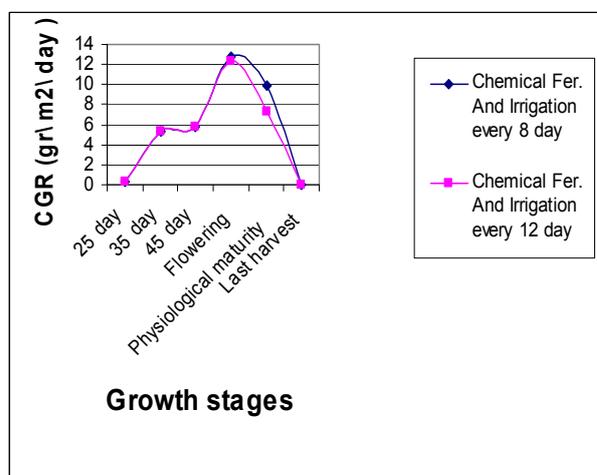


Fig. (3)

Fig. 2: Crop growth rate in four fertilizer treatment in during period of growth

Fig. 3: Crop growth rate in chemical fertilizer in two difference irrigation

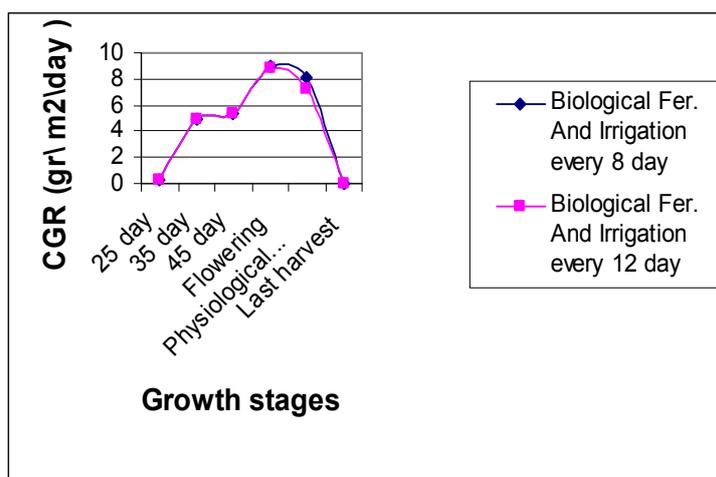


Fig. 4: Crop growth rate in biological fertilizer in two difference irrigation

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