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The Response of Durum Wheat (*Triticum durum L.*) To Organic Fertilizer under Different Environmental Conditions of Sulaimani Region- Iraq

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Abstract

To determine the effect of organic fertilizer on durum wheat (Ovanto), an experiment was conducted during two consequent growing seasons of 2012-2013 and 2013-2014. The experiment was performed in Qlyasan Agriculture Research Station, College of Agricultural Sciences- University of Sulaimani, using RCBD design with three replications. Organic fertilizer of the contents: Ec 0.19 ds. m-1, N 2%, P 2.5%, K 2.1%, O. M 60%, moisture 40% and P. H 7.5% was used at four levels of 0, 4, 8 and 12) Ton/Ha. Growth characters of the grown wheat were measured and the averages of both seasons were analyzed. The results indicated the significant effect of organic Fertilizers on the studied characteristics such as root depth (cm), plant height (cm), No. of leaves/plant, leaf dry weight (g), total dry weight (g), stem weight % and leaves weight %. While non- significant effect was recorded for the characteristics of number of tillers/plant, root dry weight (g), stem dry weight (g) and root weight, maximum values referred to the last treatment level (12 Ton/Ha) for the characteristics of plant height (cm), leaf dry weight (g) and total dry weight (g), four-Ton/Ha exhibited the maximum leaf %. While the maximum values recorded for the fertilization level of 8 were for the characters; root depth (cm); however, control level was produced the maximum values for the characteristics; No. of leaves/plant and stem %.

Keywords: Durum wheat; Organic fertilizer; Growth characters

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Introduction

Wheat (*Triticum durum*) is the most important, and the second widely cultivated crop, after corn, which played a fundamental role in combating hunger and improving the global food security [1]. The grains of wheat provide about 20% of all calories and proteins to humans and produce good flour for making bread, cakes, sweet yeast goods, cookies, and crackers as well as the use in blended mixes. In recent years, demand for wheat grains has significantly increased due to the global population growth, and thus the wheat industry is facing a competitiveness crisis [1,2]. The challenge of modernized agricultural systems is to ensure global food supply by minimizing adverse influences on the environment. During the last century, the accelerated input of mineral nitrogen (N) and phosphorus (P) fertilizers, and application of pesticides were common ways to increase yields. As a result, the demand for these fertilizers has increased drastically the production of mineral N fertilizer which is highly energy intensive [3]. The production of P fertilizer from phosphate rock causes severe environmental pollution during the mining process. Phosphorus resources are severely limited and are predicted to be exhausted within the next 40 years. In the context of resource scarcity and environmental pollution; there is a need to develop sustainable and nutrient use in efficient farming systems [4]. Organic farming, based on the use of animal manure and organic fertilizers, on nutrient cycles, which are as closed as possible and on broad crop rotations, including cover crops and green manure, aims to maintain soil fertility, which is primary for sustainability [3,5-7]. Food and environmental safety are often-cited reasons for the use of alternative soil amendments, but more, economic considerations are becoming important with a rise in popularity of organically produced foods [8]. The use of organic fertilizer has been associated with desirable soil properties including higher plant available water holding capacity of the soil, cation

exchange capacity, soil aeration, seed germination and plant growth, CEC and lower bulk density, and can promote beneficial microorganisms [9,10]. Negative effects on plant growth might also occur from non-composted organic Fertilizer added to soils [11]. The use of organic manures and composted nonchemical materials along may be effective for the further increase in crop yield. Cultivars must be able to tolerate certain unfavorable conditions typically linked with organic farming, e.g., the low soil nutrient status due to the slow release of organic fertilizers, and the stress from weeds, pests and diseases. Generally, wheat yields are lower under organic than under conventional conditions because of the increase in the population of weed, diseases, and the lower inputs of nutrients [6,12-14]. The present study was planned to find the optimum amount of organic fertilizer to enhanced wheat growth with the hypothesis that the efficiency of applied organic fertilizer varied with different environmental conditions.

Materials and Methods

This investigation was conducted during winter seasons of 2012-2013 and 2013-2014, respectively, at Qlyasan Agriculture Research Station, College of Agricultural Sciences, the University of Sulaimani, two km north-western of Sulaimani city (Lat. N35.32.375, Long. E045.73.825, Elev.703) to study durum wheat variety (Ovanto). The variety has been received from Bakrajo Research Center in Sulaimani, conducted in Randomized Completely Block Design (RCBD) with three replications. The organic Fertilizer that contents Ec 0.19 ds. m-1, N 2%, P 2.5%, K 2.1%, O. M 60%, moisture 40% and PH 7.5% (according to Agriculture research center composts) was used with four levels (0, 4, 8, and 12 Ton/Ha) each plot consisted of four rows, 4 m long, and 0.25 m space between rows.

The dates of drilling were November 11th, and 13th for 2012-2013 and 2013-2014, respectively.

The data were statistically analyzed according to the methods of analyses of variance as a general test, and combined analysis of variance across years was conducted. All possible comparisons among the means were carried out using the Least Significant Difference (L.S.D.) test at a significant level of 5% [15,16].

Studied characters

Five plants were sampled randomly from each experimental unit for measuring the growth characteristics:

1. Root depth (cm).

2. Plant height (cm).

3. No. of tillers/plant.

4. No. of leaves/plant.

5. Root %was measured according to the following equalization:

(Root % = Root weight (g)/total plant weight (g) × 100) [17,18].

6. Stem %. Was measured according to the following formula:

(Stem % = Stem weight (g)/total plant weight (g) × 100) [17,18].

7. Leaves % was measured according to the following formula:

(Leaves % = Leaves weight (g)/total plant weight (g) × 100) [17,18].

8. **Root dry weight (g):** The root of the plants was air-dried and then placed in an oven at 70°C for 24 hours. Dry roots were weighed in grams by using an electronic balance.

9. **Stem dry weight (g):** The previous method was also followed to record dry stem and leaf weight data as it was conducted about dry root weight measurement.

10. Leaf dry weight (g).

11. **Total dry weight (g):** Dry root and shoot weight data of each plant were summed up to obtain total plant dry weight. This character was also denoted in grams.

Results and Discussion

Data presented in **Table 1** reveals that root depth (cm), plant height (cm), No. of tillers/plant and No. of leaves/plant, were affected by adding organic fertilizer for the two growing seasons and their average. It was noticed that this effect was significant for the characters of Root depth (cm), plant height (cm), No. of tillers/plant and No. of leaves/plant for the first year. While in the second year this table indicated the significant effect for all characters except the number of tillers/plant, non-significantly responded to organic Fertilizer and the average of both locations. From the above results, it may be stated that the use of bio-fertilizers is beneficial in improving the growth and productivity of wheat. Corroborative findings have been reported by Sharma and Singh, for wheat grown under irrigation and fertility variables. The increment in yield and its components may be due to the increase in vegetative growth of plants and effects of organic fertilizer on enhancing root growth and dry matter accumulation [19]. These results were in harmony with previous findings who reported that the use of farmyard manure at different rates had significantly increased yield and its components. It also added that organic fertilization reduces soil pollution and support soil fertility through their effect on physical, chemical and biological characteristics of the soil. A positive effect of organic fertilizer on soil structure is also reported, that leads to better root growth and more nutrients uptake [20,21]. They also concluded that compost not only slowly releases nutrients but also prevent the loss of chemical fertilizers through desertification, volatilization and leaching by binding to nutrients and releasing with the passage of time. Thus, it is very likely that when enriched composts were applied along with chemical fertilizers, the compost prevented nutrient losses [22].

Table 2 shows the effect of weight growth characters for both years and their average. It was noticed that this effect was not significant for all characters in the first year. While for the second year and the average of both seasons non-significant effect was indicated for all characters except stem %, leaves %, leaf dry weight (g) and total dry weight (g) which were significant.

The response of wheat to fertilizer and manures on such soils had been reported to control wheat yields [23,24]. Applying various levels of organic manure and compost to wheat compensated for chemical fertilizer, which might give a substitution under field conditions [25].

Table 1 Effect of organic fertilizer on growth characters.

Organic Fertilizer (TON/Ha)	Root depth (cm)	Plant height (cm)	No. of tillers/ Plants	No. of leaves/ Plants
2012-2013 Season				
0	8.942	67.49	3.417	19.425
4	7.767	65.725	3.472	17.15
8	8.892	66.833	3.492	16.667
12	8.3	68.875	4.042	19.742
LSD (p ≤ 0.05)	**0.856**	**1.174**	**0.237**	**1.032**
2013-2014 Seasons				
0	8.4	67.55	3.417	19.383
4	7.642	67.067	4.425	18.042
8	9.108	67.617	4.033	16.85
12	8.142	69.242	3.916	17.45
LSD (p ≤ 0.05)	**0.904**	**0.863**	**n.s**	**1.136**
Average of Both Seasons				
0	8.671	67.52	3.417	19.404
4	7.704	66.396	3.949	17.596
8	9	67.225	3.763	16.758
12	8.221	69.058	3.979	18.596
LSD (p ≤ 0.05)	**0.554**	**0.649**	**n.s**	**0.683**

Table 2 Effect of organic fertilizer on weight growth characters.

Organic Fertilizer	Root %	Stem %	Leaves %	Root dry weight (g)	Stem dry weight (g)	Leaf dry weight (g)	Total dry weight (g)
2012-2013 Season							
0	11.263	71.297	17.227	0.702	4.441	1.074	6.216
40	10.653	71.223	18.12	0.667	4.459	1.134	6.26
80	10.533	71.88	17.52	0.676	4.588	1.118	6.382
120	10.507	72.107	17.36	0.675	4.647	1.118	6.44
LSD (p ≤ 0.05)	**n.s**	**n.s**	**n.s**	**n.s**	**n.s**	**n.s**	**n.s**
2013-2014 Season							
0	10.713	77.33	11.95	0.664	4.831	0.74	6.235
40	10.157	69.64	20.2	0.671	4.603	1.337	6.611
80	10.127	70.977	18.893	0.726	5.089	1.355	7.171
120	9.11	70	20.913	0.676	5.198	1.553	7.426
LSD (p ≤ 0.05)	**n.s**	**4.391**	**3.732**	**n.s**	**n.s**	**0.262**	**0.543**
Average of Both Seasons							
0	10.988	74.313	14.588	0.683	4.636	0.907	6.226
40	10.405	70.432	19.16	0.669	4.531	1.236	6.436
80	10.33	71.428	18.207	0.701	4.839	1.236	6.776
120	9.808	71.053	19.137	0.676	4.923	1.336	6.933
LSD (p ≤ 0.05)	**n.s**	**1.994**	**1.69**	**n.s**	**n.s**	**0.122**	**0.291**

Table 3 The effect of years on a means of growth characters.

Years	Root depth (cm)	Plant height (cm)	No. of tillers/ plant	No. of leaves/plant
2012-2013	8.475	67.231	3.606	18.246
2013-2014	8.323	67.869	3.948	17.931
LSD (p ≤ 0.05)	**n.s**	**n.s**	**n.s**	**n.s**

Incorporation of organic manures and rate of chemical fertilizers were significantly affected shoot dry matter of wheat [26]. Increase in fresh weight of wheat with the incorporation of organic fertilizers has also been reported [27]. Use of organic and mineral fertilizers also influenced the nutrient uptake of the shoot. Farmyard manure and recommended rate of mineral fertilizers were found to have highest NPK uptake in the shoot. Incorporation of farmyard manure provided ideal conditions to plant by increasing Phosphate mobilization and improving microbial activities [28,29]. Incorporation of organic Fertilizer

Table 4 The effect of years on a means of weight growth characters.

Years	Root %	Stem %	Leaves %	Root dry weight (g)	Stem dry weight (g)	Leaf dry weight (g)	Total dry weight (g)
2012-2013	10.739	71.627	17.557	0.680	4.534	1.111	6.325
2013-2014	10.027	71.987	17.989	0.684	4.930	1.246	6.861
LSD (p ≤ 0.05)	**0.578**	**n.s**	**n.s**	**n.s**	**0.255**	**0.082**	**0.167**

along with mineral fertilizers increased Nitrogen and Phosphate uptake in plant [30]. Other researchers have also concluded that crop growth might be improved by the use of organic materials [31-33]. Previous studies have shown that organic materials (compost, manures) enhance nutrient use efficiency by slow releasing of nutrients and reducing their losses [28,29,34,35].

Tables 3 and 4 show the effect of years on a means of growth characters and their average. It was noticed that there was non-significant effect for all characters in both years except root %, stem dry weight (g), leaf dry weight (g) and total dry weight (g).

The addition of organic fertilizer increases phosphorus mobilization and soil microbial activities; it might also contribute to improving nutrition as well as the crop root system. The increase in fresh weight has also been reported [23] concluding that favourable environment results in an increased activity and increased water and nutrient use efficiency resulting in more plants [36,37]. The difference in nutrient absorption greatly impacts growth and yield potential [36]. These findings are in support of previous findings that concluded that compost application improved all the growth parameters [38,39].

Conclusion

The use of 90 Ton/Ha of organic fertilizer for durum wheat cultivation cause to increase on the following characters (Plant height, Leaf dry weight and Total dry weight) but non-significantly increased for most other growth characters and weight of root and shoot led to the low soil nutrient status due to the slow release of organic fertilizers and the stress from weeds and pests. The 2nd year significantly affected for some characters compare to the first year led to improving environmental condition in the 2nd year but in the most characters, the effect of years is non-significant. It is, therefore suggested using organic fertilizer and rate of chemical fertilizer for durum wheat production.

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