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Research Article

SOME OF YIELD RELATED CHARACTERISTICS IN WHEAT (*TRITICUM AESTIVUM*) COULD BE HIGHLY EFFECTIVE ON THE CROP GRAIN YIELD UNDER BIO-REGULATORS APPLICATION

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ABSTRACT
Investigations about effect of bio-stimulators on crops are scares until now. This study was aimed to multiple regression analysis for studied traits in wheat cultivars under bio-regulators application. Studied treatments were wheat new released cultivars included *Sabalan* and *L 4057* in main plot; and factorial combinations of irrigation cutting at late growth season × Phosnotern foliar spraying as a plant growth bio-stimulator as sub plot. In this study, to formulate the relationship among independent growth variables measured in the experiment for wheat crops with a dependent variable, multiple regression analysis was carried out. Plants under foliar spraying of the bio-stimulator produced 125 g m^{-2} greater seed yield than non-sprayed ones. The stepwise regression analysis verified that among studied characteristics in wheat cultivars 250 seed weight was 2.43 and 1.56 times effective than grain number per spike and spike weight, respectively, on grain yield. Also, the results revealed that the 250 seed weight, grain number per spike and spike weight had a marked increasing effect on the both wheat cultivars grain yield.

Key words*: Increasing Effect, Phosnotern Foliar Spraying, Regression Analysis.*

INTRODUCTION
In terms of total production tonnages of Wheat (*Triticum aestivum*) used for food, it is currently second to rice as the main human food crop and ahead of maize, after allowing for maize's more extensive use in animal feeds (FAOSTAT, 2013).
If crops have certain phenological phases in which they are tolerant to water stress, deficit irrigation can increase the ratio of yield over crop water consumption (Geerts and Raes, 2009) by either reducing the water loss by unproductive evaporation, and/or by increasing the proportion of marketable yield to the totally produced biomass, and/or by increasing the proportion of total biomass production to transpiration due to hardening of the crop - although this effect is very limited due to the conservative relation between biomass production and crop transpiration (Steduto *et al.*, 2007) - and/or due to adequate fertilizer application (Steduto and Albrizio, 2005) and/or by avoiding bad agronomic conditions during crop growth, such as water logging in the root zone, pests and diseases, etc (Pereira *et al.*, 2002). In a field experiment on rapeseed, Dehshiri *et al.*, (2006) showed that treatments irrigated after 50, 80 and 110 mm evaporation from pan did not have negative effect on seed yield. In fennel studied cultivar *Malayer*, with a view to essential oil yield, there is no significant difference between 100mm and 130mm water deficit levels, and both of them produced greater yield than control (Sajjadnia, 2013).
Some very interesting effects of bio-stimulators are described concerning their stimulating effect on nutrient uptake (Fortun and Lopez, 1982; Tattini *et al.*, 1989), counteracting salt and drought stress as well as temperature stress. The positive effect of bio-stimulators on availability and uptake of nutrients like calcium, magnesium and phosphorus due to chelating should be stressed. Stress reducing effects of bio-stimulators could be found especially in nutrient solutions with too low or too high pH values and also in stress situations because of extreme temperature (Boehme *et al.*, 2000).
Based on the results the application of bio-stimulators, it seems to be useful and should investigate further. It should be stressed that all very different bio-stimulators had in most cases a stimulating effect on shoot development and number of marketable fruits. It is surprising, that all substances tested

stimulated the vegetative growth while yield was higher if LACTOFOL was applied (Boehme *et al.*, 2006).

Investigations about effect of such bio-stimulators are scares until now. Also, for causal explanations much more experiments are necessary. This study was aimed to multiple regression analysis for studied traits in wheat cultivars under bio-regulators application.

MATERIALS AND METHODS

Experimental Location

Some of meteorological data for experimental area in Ardabil, Iran during April-August 2014 have been depicted in Table 1.

Table 1: Meteorological data for experimental area in Ardabil during April-August 2014

	April	May	June	July	August
Precipitation (mm)	10.7	48.1	57.3	0.7	16
Minimum temperature (^{o}C)	2.4	4.2	9.3	11.3	12.4
Maximum temperature (^{o}C)	16.9	18.2	22.9	23.8	22.3
Mean daily temperature (^{o}C)	9.6	11.2	16.1	17.5	17.3
Minimum humidity (%)	40	45	44	43	52
Maximum humidity (%)	87	86	89	85	91
Mean humidity (%)	64	66	67	64	71
Total of sun days	214.5	247	280.1	346.9	253.9

Source: Ardabil meteorological office, Iran

Experimental Procedure

Plots were arranged in a split factorial experiment based on randomized complete block design with 3 replications. Studied treatments were wheat new released cultivars included *Sabalan* and *L 4057* in main plot; and factorial combinations of irrigation cutting at late growth season × Phosnotern foliar spraying as a plant growth bio-stimulator as sub plot.

Stepwise Regression Analysis

In this study, to formulate the relationship among independent growth variables measured in our experiment for wheat crops with a dependent variable, multiple regression analysis was carried out.

RESULTS AND DISCUSSION

In normal irrigation regime crop seed yield increased 136 g m^{-2} compared to stressed plants. Lower number of secondary branches (8.2 branches) in fennel plants observed in normally irrigated treatment (70mm evaporation from pan). While, fennel plants under limited irrigation levels produced greater secondary branches (10 branches) than control. Plants under sever water deficit (irrigated when done 130mm evaporation from pan) produced lower seed yield than 100mm evaporation level.

Similarly, plants under foliar spraying of the bio-stimulator produced 125 g m^{-2} greater seed yield than non-sprayed ones. All bio-substances have beneficial effects on plants in stress situations. Therefore, a combination of these substances should be investigated to stabilize the growing conditions. Bio-stimulators affect better seed germination (Jelačić *et al.*, 2006; Yildirim *et al.*, 2002), and represent stimulators of plant biological activity, having simultaneous effects on the plant yield.

In statistics, stepwise regression includes regression models in which the choice of predictive variables is carried out by an automatic procedure (Draper and Smith, 1981). In this study, to formulate the relationship among seven independent growth variables measured in our experiment for wheat crop with a dependent variable, multiple regression analysis was carried out for the stem height (X_1), spike weight (X_2), spike length (X_3), grain number per spike (X_4), grain weight per spike (X_5), 250 seed weight (X_6),

biological yield (X_7); and grain yield (GY) as a dependent variable. The multiple regression equation for grain yield is as follows:

$$GY = 33.888 + 2.009(X_1) + 5.765(X_2) + 8.000(X_3) + 41.780(X_4) + 4.335(X_5) + 71.222(X_6) + 5.896(X_7) \quad (1)$$

Table 2: Standard regression coefficients, T values and probability level of traits in model

	Spike weight	Grain number per spike	250 seed weight
Standard regression coefficients	+0.421	+0.421	+0.600
T values	+1.900	+1.225	+2.980
Prob.	0.040	0.009	0.009

Furthermore, the stepwise regression analysis was also carried out for the data obtained to test the significance of the independent variables affecting the grain yield. The stepwise regression equation is as follows:

$$GY = 124.456 + 2.456\,(X_2) + 5.784\,(X_4) + 44.521\,(X_6);\ R^2 = 89 \quad (2)$$

Conclusion

The stepwise regression analysis verified that among studied characteristics in wheat cultivars 250 seed weight was 2.43 and 1.56 times effective than grain number per spike and spike weight, respectively, on grain yield, as reported by Steduto and Albrizio (Draper and Smith, 1981) on wheat and sorghum under micronutrient spraying. Also, the results revealed that the 250 seed weight, grain number per spike and spike weight had a marked increasing effect on the both wheat cultivars grain yield.

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