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Response of Three Oat Varieties in Yield Characteristics and Components under the Influence of Three Levels of Nitrogen Fertilizers

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Annotation: A field experiment was conducted at the College of Agriculture Research Station, Al-Muthanna University, located in the Al-Bandar area, during the winter season, to study the response of three oat cultivars to different nitrogen levels, the experiment was conducted using a split-plot design. The cultivars (Wallaro, Carlloup, and Wild Oat) were placed in the main plots. Fertilizer levels in the sub-plots were 50, 100, and 150 kg ha-1. The results indicated significant superiority of the cultivars in all studied traits. Wallaro yielded the highest averages on grains number per dahlia (84.33 grains), 1000 grains weight (41.62 gm), grain yield (7.9 tons ha-1), biological yield (17.449 tons ha-1), harvest index (21.43%), and protein content (11.58%). While the first cultivar, Wild Oat, yielded the lowest averages on grains number (71.67 grains), 1000 grains weight (32.22 gm), grain yield (6.27 tons ha-1), biological yield (15.154 tons ha-1), and protein content (8.65%). As for fertilizer levels, they significantly outperformed most traits. The second level (100 kg ha-1), yielded the highest average grain yield

(7.914 tons ha-1), biological yield (17.418 tons ha-1), harvest index (25.33%). The third level (150 kg ha-1), yielded the highest average number of grains (86.33 grains). The first level yielded the lowest averages for the trait number of grains (82.67 grains), grain yield (6.26 tons ha-1), biological yield (15.292 tons ha-1), and harvest index (21.56%). Regarding interactions, there was no significant effect for most traits except for the number of grains per spike. The combination (Wallaro × 150 kg ha-1) yielded the highest average (86.33 grains). The combination (Wils oat × 50 kg ha-1) yielded the lowest average (67.67 grains).

Keywords: oat varieties, yield characteristics, nitrogen fertilizers.

Introduction:

Oats (*Avena sativa*) are an annual herbaceous plant of the Poaceae family, it ranks fourth in economic importance after wheat, rice, and maize. It accounts for more than 80% of the global cultivated area and is found in humid, temperate regions (Ghani, 2016). The global cultivated area is 54.9 million hectares, with a production of 54.23 million tons of grain., The largest oat-producing countries are Russia, Canada, and Australia. It is used for human and animal feed (USDA, 2018; Al-Furaih *et al*., 2020).

Oats have maintained their position among other crops, due to their high nutritional value, ease of cultivation, and adaptability, oats can be successfully grown in a variety of soil types, they thrive in fertile, well-drained, mixed clay soils. They are more tolerant of soil reactions than wheat and barley (Al-Hamdawi, 2017).

The challenge facing researchers and those interested in the agricultural sector is to correctly identify the factors limiting production and mitigate their impact, by adopting modern technologies to ensure increased yield per unit area. The important issues in this field is selecting the appropriate variety and adding nutrients (Manea and Kadhum, 2014).

The availability of nutrients (nitrogen) during the crop growth period plays an important role in increasing vegetative growth and, consequently, increasing the quantity and quality of the grains produced, due to its significant impact on crop growth, which the plant requires at high rates to compensate for the deficiency in the soil during crop cultivation, helps determine the crop's needs. Production efficiency can be increased through several agricultural processes. The use of nitrogen fertilizers, which are an important agricultural factor affecting the production and quality of various crops, including winter grain crops. Nitrogen is the primary nutrient, determining crop production and its use at levels appropriate to the crop's needs at different growth stages (Al-Hasnawi, 2016). 1000 grains weight and the yield of oat grains increase with increased nitrogen fertilization (Maral *et al*., 2008).

The experiment aimed to determine which fertilizer levels lead to increased yield and its components for three oat varieties.

Materials and Methods

A field experiment was conducted at the Agricultural Research Station, College of Agriculture, Al-Muthanna University. A soil sample was taken at a depth of 30 cm, for study, analysis, and physical and chemical characterization (Table 1). The aim was to determine the response of different oat cultivars to different levels of nitrogen fertilization.

Table (1) Some physical and chemical properties of the soil of the experimental field before planting*.

Properties	Items	Unit	Value
Physical	**Sand**	gm. kg^{-1} soil	401.00
	Silt		345.00
	Clay		254.00
	Soil texture	Loamy soil	
chemical	**ECe**	ds. m^{-1}	3.80
	pH	---	7.30
	Organic mater	gm. kg^{-1} soil	3.20
	N	mg. kg^{-1} soil	20.45
	P		18.90
	K		200.67

Traits studied:

Grain number per dahlia: Ten dahlias were taken, sorting, and cleaning. The total grains number was calculated and the overall average calculated.

1000 weight grains: 1000 grain sample of the grain yield were used, by using a sensitive scale (gm).

Grain yield: Harvesting the two middle rows, sorting only the grains, weighing, and then converting to tons per hectare.

Biological yield: Harvesting the two middle rows, weighing the entire plant (straw + seeds), and converting to tons per hectare.

Harvest index: Calculated by dividing the grain yield by the biological yield ×100.

Protein percentage: Calculated by a Cropscan device.

Statistical analysis:

The data were statistically analyzed after being collected and tabulated using the Genstat program at a significance level of 0.05.

Results and Discussion

Table (2) indicates that all study factors significantly outperformed each other in terms of the number of grains per dahlia. Wallaro variety outperformed, yielding the highest value (84.33 grains per dahlia). While Wild Oat variety recorded the lowest value (71.67 grains per dahlia). This is attributed to the genetic nature of the variety, which is a quantitative trait closely linked to genetic factors (Al-Hamdawi, 2017; Mahadevan *et al*., 2018).

Regarding fertilization levels, 150 kg ha^{-1} level recording the highest value (86.33 grains per dahlia), while 50 kg ha^{-1} level recorded the lowest value, (82.67 grains per dahlia). This is attributed to the increased number of grains per dahlia, due to the availability of mineral nutrients N, P, and K, which play an important role in stimulating many vital processes within the plant, thus, regulating the action of hormones, controlling the effect of auxin in creating apical dominance in the dahlia, contributes to increasing the percentage of grain set on the dahlia axis, which positively affects the number of grains per dahlia. This trait is a desirable trait, as it is one of the main components of grain yield (Al-Hasnawi, 2016).

Regarding the interaction, the combination (Wild Oat× 150 kg ha^{-1}) yielded the highest value (86.33 grains per dahlia), while the combination (Wallaro× 50 kg ha^{-1}) yielded the lowest value (67.67 grains per dahlia).

Table (2) The effect of varieties and different levels of nitrogen fertilizer and the interaction on grains number per dahlia.

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	67.67	68.33	79.00	71.67
Carllop	76.00	75.33	82.67	78.00
Wallaro	82.67	84.00	86.33	84.33
Mean	75.44	75.89	82.60	
L.S.D$_{0.05}$	**Varieties**	**Nitrogen fertilization**		**Interaction**
	5.199	1.967		5.225

Table (3) shows the significant superiority of varieties and nitrogen fertilization in the weight of 1000 grains. Wallaro variety yielded the highest average (41.62 gm), while Wild Oat variety, yielded the lowest average (32.22 gm). The differences between varieties are due to the variety's efficiency in utilizing photosynthetic products, this was reflected in increased nutrient assimilation and accumulation in the grains, which subsequently increased their weight (Al-Halfi and Falih, 2017).

As for nitrogen fertilization, 50 kg ha^{-1}, yielded the highest value (43.8 gm), while 150 kg ha^{-1}, yielded the lowest value (37.56 gm). This is attributed to the fact that the increased number of grains in the flower stalks (Table 2) at high nitrogen levels led to increased competition within the plant for carbon assimilation products, resulting in smaller grains. Due to the scarcity of materials needed to fill the grains, which negatively impacted their weight, an increase in one component of the yield may lead to a decrease in the other component, due to the compensation situation (Pecio and Bichonski, 2010; Lafond, 2013).

The interaction had no significant effect.

Table (3) The effect of varieties and different levels of nitrogen fertilizer and the interaction on the 1000 grains weight.

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	31.73	34.23	30.70	32.22
Carllop	39.60	37.20	33.80	36.87
Wallaro	43.80	43.50	37.56	41.62
Mean	38.38	38.31	34.02	
L.S.D$_{0.05}$	**Varieties**	**Nitrogen fertilization**		**Interaction**
	2.212	1.756		N.S

Table (4) shows the significant superiority of cultivars and nitrogen fertilization in grain yield. Wallaro cultivar yielded the highest average (7.9 tons ha^{-1}), while Wild Oat cultivar, yielded the lowest average (6.27 tons ha^{-1}). This was attributed to the cultivar's superiority in grain number and thousand-grain weight. This is consistent with Ali *et al.* (2016) Mahadevan *et al.* (2016), who indicated differences between oat cultivars in grain yield.

As for nitrogen fertilization, 100 kg ha^{-1}, yielded the highest value, (7.914 tons ha^{-1}), while 50 kg ha^{-1}, yielded the lowest value (6.26 tons ha^{-1}). This is consistent with Maral *et al*. (2013) and Al-Abdullah (2015), who demonstrated a significant increase in grain yield with increased nitrogen levels.

The interaction had no significant effect.

Table (4) The effect of varieties and different levels of nitrogen fertilizer and the interaction on grain yield (tons ha^{-1}).

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	5.497	7.073	6.267	6.279
Carllop	6.237	7.957	7.293	7.162
Wallaro	7.070	8.713	8.137	7.973
Mean	6.268	7.914	7.232	
$L.S.D_{0.05}$	Varieties	Nitrogen fertilization		Interaction
	0.2262	0.3038		N.S

Table (5) shows the significant superiority of cultivars and nitrogen fertilization in terms of biological yield. Wallaro cultivar yielded the highest average (17.449 tons ha^{-1}), while Wild Oat cultivar, yielded the lowest average (15.154 tons ha^{-1}). This is attributed to the cultivar's superiority in terms of number of grains, thousand-grain weight, and grain yield (Al-Hasnawi 2016).

As for nitrogen fertilization, 100 kg ha^{-1} level yielded the highest value (17.418 tons ha^{-1}), while 50 kg ha^{-1} level yielded the lowest value (15.292 tons ha^{-1}), agree with Maral *et al.* (2013) and Al-Abdullah (2015), who demonstrated a significant increase in bioavailability with increased nitrogen levels.

The interaction had no significant effect.

Table (5) The effect of varieties and different levels of nitrogen fertilizer and the interaction on the Biological yield (tons ha^{-1}).

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	14.300	16.210	14.953	15.154
Carllop	15.243	17.507	16.070	16.273
Wallaro	16.333	18.537	17.477	17.449
Mean	15.292	17.418	16.167	
$L.S.D_{0.05}$	Varieties	Nitrogen fertilization		Interaction
	0.3953	0.3220		N.S

Table (6) shows the significant superiority of cultivars and nitrogen fertilization in the harvest index. Wallaro cultivar yielded the highest average (21.43%), while Carlloup cultivar yielded the lowest average (21.43%), this result was consistent with Al-Hasnawi (2016).

As for nitrogen fertilization, 100 kg ha^{-1} level yielded the highest value (25.33%), while 50 kg ha^{-1} level yielded the lowest value (21.56%). This is attributed to the improved dry matter conversion efficiency and the higher grain yield value (Table 5), agree with Maral *et al.* (2013) and Al-Abdullah (2015), who demonstrated a significant increase in harvest index with increased nitrogen levels.

The interaction had no significant effect.

Table (6) The effect of varieties and different levels of nitrogen fertilizer and the interaction on the harvest index (%).

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	19.80	23.28	21.22	23.44
Carllop	21.48	25.46	23.36	21.43
Wallaro	23.40	27.25	25.61	25.42
Mean	21.56	25.33	23.40	
L.S.D$_{0.05}$	Varieties	Nitrogen fertilization		Interaction
	0.484	0.585		N.S

Table (7) indicates a significant superiority of the cultivars on Protein percentage. It was found that Wallaro cultivar yielded the highest average yield (11.58%), while Wild Oat cultivar yielded the lowest average yield (8.65%). This result was consistent with Bilal *et al*. (2017).

Nitrogen fertilization and interaction had no significant effect.

Table (7) The effect of varieties and different levels of nitrogen fertilizer and the interaction on the Protein percentage.

Varieties	Nitrogen fertilization levels (kg ha^{-1})			Mean
	50	100	150	
Wild oat	8.900	8.300	8.767	8.656
Carllop	10.133	10.500	10.567	10.400
Wallaro	11.500	11.767	11.500	11.589
Mean	10.178	10.189	10.278	
L.S.D$_{0.05}$	Varieties	Nitrogen fertilization		Interaction
	0.7691	N.S		N.S

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