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Effect of Some Agricultural Practices on the Productivity of Black Cumin (*Nigella sativa* L.) Grown under Rainfed Semi-Arid Conditions

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ABSTRACT

Black cumin (*Nigella sativa* L.) plant is an annual spicy herb and belongs to the *Ranunculaceae* family. It has a rich nutritional value and has many medicinal usages. This study was conducted to investigate the effect of sowing dates, nitrogen fertilization rates and plant density on black cumin productivity under the rainfed semi-arid conditions of Jordan. The factors were arranged in a split-split-plot in a randomized complete block design with three replicates and two locations. Results at Mushaqar location showed that planting on December 2 gave 25.1% and 54.1% more seed yield over planting at the end of December or at early January, respectively. Similarly, biological yield at the first date (December 2) was higher by 53.5% and 87% as compared to the 2nd and 3rd dates, respectively. Harvest index behaved differently, where the highest harvest index was obtained in 2nd and 3rd planting dates. At Maru location, highest harvest index value was obtained in second date with an increase of 29.2% and 33.5% over planting in 1st and 3rd date, respectively. Weight of 1000 seed was significantly affected by planting dates and plant density at the two locations. The highest 1000 seed weight at Mushaqar was obtained under 35 kg seed ha^{-1} followed by 25, 30 and 40 kg ha^{-1}. Whereas at Maru, the highest seed weight was obtained under 30 and 35 kg seed $ha^{-1.}$ First planting date gave the tallest plants at Mushaqar, whereas 25 kg seeds ha^{-1} gave the tallest plants at Maru. Seed yield was significantly correlated at both locations with plant height and weight of 1000 seeds. Neither plant density treatments nor urea treatment applied at cultivation date showed significant effect on seed yield for the two locations.

Keywords: Black Cumin, *Nigella sativa*, Crop Management, Semi-arid Environment.

1. INTRODUCTION

Black cumin (*Nigella sativa* L.) is an annual spicy herb and belongs to the *Ranunculaceae* family. Sometimes it is referred to as nigella or black seeds. It is native to the Mediterranean and Western Asia regions. It is cultivated in many parts of the world including the Middle East, North Africa and Asia where maximum diversity is found. (Abu-Jadayil, 2002; Donmez and Mutlu, 2004; Tierra, 2005).

As herb**,** black cumin has a rich nutritional value; it contains monosaccharides. The seed is rich in fatty acids, proteins and carbohydrates. It contains all essential amino acids and rich source of vitamins and minerals (Abu-Jadayil *et al*., 1999; Atta, 2003).

Seeds are used both as a condiment in bread and

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cakes and in the preparation of traditional sweet dishes, pastry, pickles, and used as candies and liquors (Luetijohann 1998; Thippeswamy and Naidu, 2005; Tierram, 2005). In addition, black cumin oil has many medicinal usages (Ali and Blunden 2003).

Very limited information is available in the literature about on cumin cultivation and production practices. Ahmed and Haque (1986) and Ahmed *et al.* (2004) achieved highest yield per unit area with early sowing in November. D'Antuono *et al.* (2002) reported that biological yield and seed yield decreased with delayed sowing, which was due to reduction in both seed number per plant and mean seed weight. They also found that the harvest index is high and showed an increasing trend in late sowing. On the other hand, seed oil content increased from the first to the second sowing date, then dropped to lower values in the third sowing date, and essential oil composition decreased with delayed sowing.

Singh and Singh *(*1999) indicated that the moderate doses of nitrogen and phosphorus fertilizer increase the seed yield of black cumin. Ahmad *et al.* (2004) reported that the split dose of nitrogen might increase black cumin yield. Ashraf *et al.* (2005) recorded maximum biological yield and seed yield at 30 and 60 kg N ha^{-1}.

Ahmad *et al. (*2004) reported that 12 to 15 kg seed ha^{-1} are recommended for black cumin cultivation and the amount will be reduced to 10 to12 kg seed ha^{-1} when the seed drill is used.

Limited information is available on the proper agricultural practices for black cumin cultivation under the Mediterranean semi-arid environment. Therefore, this research was conducted to find out the effect of sowing date, nitrogen fertilizer and plant density on yield and quality of black cumin, under the rainfed conditions of Jordan.

2. MATERIALS AND METHODS

2.1 Site Description

The experiment conducted during 2004/2005 season in two locations; Maru and Mushaqar research stations both have a Mediterranean environment with cold winter and relatively hot summer.

Mushaqar located in the middle of Jordan at 35° 46′ longitude and 31° 47′ latitude with an elevation of 800 m above sea level. The average rainfall for a ten years period (95/96-2003/2004) was 319.2 mm with 462.5 mm precipitation received during the season when the experiment was conducted. Average lowest temperature was 6.9 °C and highest was 20.1 °C.

Maru agricultural research station is located in the north of Jordan at 35° 53′ longitude and 32° 36′ latitude with an elevation of 530 m above sea level. The average rainfall for a ten years period (95/96-2003/2004) was 407.9 mm with 431.4 mm precipitation during the season when the experiment was conducted. Average lowest temperature was 9.2 °C and highest was 21.4 °C.

Soil fertility status indicated the presence of adequate amounts of phosphorus and potassium, however soil analysis in the two sites showed low soil nitrogen levels, where the nitrogen percentage at the top 20 cm of the soil at planting time was 0.09% in the two locations.

2.2 Treatments and design

The following three treatments were evaluated:

1. Three planting dates were used as follows: For Mushaqar; December 2, 2004; December 30, 2004; and January 17, 2005, and for Maru; December 1, 2004; December 29, 2004; and January 30, 2005.
2. Three rates of nitrogen fertilizer in the form of urea (46% N) were applied at planting these were: without nitrogen (control), 20 and 40 kg N ha^{-1}.

3. Four seed rates; 25 kg ha^{-1} (1000 plants m^{-2}), 30 kg ha^{-1} (1200 plants m^{-2}), 35 kg ha^{-1} (1400 plants m^{-2}) and 40 kg ha^{-1} (1600 plants m^{-2}).

Treatments were arranged in split-split-plot in a randomized complete block design with three replications. Planting dates were the treatments applied to the main plots, nitrogen fertilizer rates applied to sub-plot and plant density to the sub-sub-plots. The experimental plot consists of six rows, four meters long with 0.18 m spacing between rows.

Harvesting was done for three meters of the four central rows (2.2 m^2) from each sub-sub plot, leaving the outer 2 rows and 0.5 meters across each side of the plot as borders.

Harvesting dates for Mushaqar experiment was in June 8 for the first date, and June 15 for the second and the third date. Whereas Maru experiment was harvested on May 30 for the first date, and June 9 for the second and the third dates.

2.3 Data Collection

Data Collected on Plot Basis

Days to emergence, days to flowering, days to maturity, plant height, biological yield, seed yield, and harvest index.

Data on Single Plants

At maturity, ten plants were randomly selected from each experimental plot and the following measurements were taken and converted to per plant:

Number of main branches, number of capsules, number of seeds /capsule, and weight of 1000 seeds.

Seed Oil Content

Seed total oil content was measured in two replicates (72 experimental plots) only from Mushaqar location. The extraction from seeds was performed by using organic solvent according to the procedure by Pomeranz and Meloan (2000). Whereas essential oil was extracted from three samples only by using steam distillation method according to the procedure by Li and Jiang (2004).

2.4 Statistical Analysis

Data analysis was performed using MSTATC program. Treatments means were compared using Least Significant Difference (LSD) at 5 % probability according to Steel and Torrie (1980). The relationships between some studied characters were conducted by using Excel program.

3. RESULTS

3.1 Seed yield, Biological Yield and Harvest Index

At Mushaqar location, planting in December 2 gave 25.1% and 54.1% more seed yield over planting at the end of December or at early January, respectively (Table 1). Similarly, biological yield at the first date (December 2) was higher by 53.5% and 87% as compared to the 2nd and 3rd dates, respectively. Harvest index behaved differently, where the highest harvest index was obtained in 2nd and 3rd planting dates and the lowest at the first date with 22.2% different.

At Maru location, only harvest index was affected significantly by planting date; where highest harvest index value was obtained in second date with an increase of 29.2% and 33.5% over planting in 1st and 3rd date, respectively (Table 1).

The correlation between seed yield and planting date at Mushaqar was linear, negative, and significant (R^2=0.99, b=-7.263); as planting delayed seed yield decreased (Figure 1). The same trend was observed at Maru location but the association was not statistically significant (R^2 = 0.81, b= -3.216) (Figure 2).

Seed yield and biological yield was significantly affected by the interaction between planting dates, nitrogen fertilizer rates and seed rates at Maru location only. The highest seed yield (1183 kg ha^{-1}) was obtained from the combinations of the first planting date with 40 kg N ha^{-1} and 40 kg seeds ha^{-1}, and the first date with 20 kg N ha^{-1} and 25 kg seed ha^{-1}. The highest biological yield (5758 kg ha^{-1}) was obtained from the combination of the first sowing date with 40 kg N ha^{-1} and 40 kg seed ha^{-1},

3.2 Yield Components

At Mushaqar location, only weight of 1000 seeds was significantly affected by planting dates and seed rates. Planting on December 2 gave an increase in weight of 1000 seeds of 5.3% and 9.4% over the other two dates, respectively (Table 2). On the other hand, the highest seed weight was obtained with 35 kg seed ha^{-1}, followed by 25, 30 and 40 kg ha^{-1}. However, nitrogen fertilizer rates had no significant effect on this character.

Similar results were obtained at Maru location (Table 3); planting on December 2 and at the end of December gave the highest seed weight as compared to planting on mid January with 10 % difference. On the other hand, the highest 1000 seed weight was obtained under 30 and 35 kg seed ha^{-1} while the lowest was obtained with 25 kg ha^{1}.

The interactions between planting dates and nitrogen fertilizer rates for the number of branches per plant at Maru were significant. The highest number (2.8 branches) was obtained when the crop was planted on the first planting date (December 2) with 40 kg N ha^{-1}, whereas the lowest (1.7 branches) was obtained when the crop was planted in the second date with 40 kg N ha^{1}.

3.3 Plant Height

At Mushaqar (Table 2), planting on December 2 gave 7.9 cm taller plants than planting on December 29 and 10.5 cm taller plants than planting on January17. Similarly, planting on December 29 gave 2.6 cm taller plants than those planted on January 17, 2005. For Maru location (Table 3), 25 kg seed ha^{-1} gave about 3.2 % increase in height over the 30 and 40 kg seed ha^{-1}.

The interaction between the three factors was significant at Maru. The combination of first planting date with 40 kg N ha^{-1} and 40 kg seed ha^{-1} gave the tallest plants (35.5cm); while the combination of the second planting date with no fertilizer and 40 kg seed ha^{1} gave the shortest plants (24.0cm).

3.4 Days to Flowering and Days to Maturity

For Mushaqar location, the number of days from emergence to flowering was 115, 93 and 80 for the first, second and third planting date, respectively. For Maru location, it took less number of days as compared to Mushaqar for plants to reach 50% flowering, which was 107, 87 and 71 days for the first, second and third date of planting, respectively (Table 4). As for days to maturity at Mushaqar location, the number of days from emergence to maturity was 154, 130 and 114 for the first, second and third planting date, respectively. Whereas for Maru location, it took 145, 125 and 104 days for the first, second and third planting date, respectively, which was shorter than the time needed at Mushaqar location (Table 4).

3.5 Correlations among the Studied Characters

Coefficients of linear correlation are presented in Table 5. Only significant r values were presented. Seed yield was positively correlated with biological yield, weight of 1000 seeds and plant height at the two locations; with number of branches / plant, number of capsules/ plant at Maru; and with number of seeds / capsules at Mushaqar. A significant negative correlation was found with harvest index at Mushaqar only. The highest coefficient of determination (r^2) values were measured for seed yield with biological yield (0.84 ** Mushaqar, 0.71 ** Maru), weight of 1000 seed (0.36 ** Mushaqar, 0.19 ** Maru) and with plant height (0.49 ** Mushaqar, 0.29 ** Maru).

Biological yield was positively correlated with weight of 1000 seeds and plant height at the two locations, with r^2 values of 0.36 with 1000 seeds weight at Mushaqar, 0.72 and 0.48 with plant height for Mushaqar and Maru, respectively. On the other hand, biological yield was negatively correlated with harvest index at the two locations with r^2 values of 0.36 at Mushaqar.

Oil Percentage

The evaluated treatments and their interactions have no significance effect on oil percentage. The total oil percentage ranged from 38.4 to 39.9 % which is close to those found in other studies on black cumin, such as the study by Rchid *et al* (2004) Kokdil and Yilmaz (2005). Essential oil values in these samples were 0.65%, 0.86% and 0.92 %. which are close to those found in other studies (0.5-1.5 %) (Al-Naggar, 2003 and Newsletter Archive, 2004).

4. DISCUSSION

Seed is the major product and the used part of black cumin, which is directly utilized for nutritional and medicinal purposes. However, in West Asia countries, crop straw is also important as animal feed. Optimum planting date is very important factor that contributes to yield increase. Yield results showed that planting on December 2 at Mushaqar gave a significant increase in seed yield. Plants at first planting dates took 154 days from emergence to maturity, which exceeded the period in the 2nd and 3rd dates by 24 and 40 days, respectively (Table 4). The extended growth period in early sowing allowed the plants to better utilize soil moisture and nutrients for a longer period, which result in more biological and seed yield. Moreover, early planting resulted in early flowering and maturity, which allowed the plants to escape the late season drought; this was found by Haddad, 1983; and Khanfar, 1996 who were working on chickpeas under Jordan rainfed conditions. Late season drought is a common phenomenon in rainfed agriculture of the Mediterranean climate and so in Jordan; very small amounts of rain received during the months of April and May, a period coincide with seed filling and seriously affect yield.

Furthermore, the regression coefficient values for the relationship between planting dates and seed yield were -7.3 for Mushaqar and -3.2 for Maru. This indicates that a one-day delay in planting after December 2 will result in 7.3 kg ha^{-1} decrease in seed yield at Mushaqar, and a decrease of 3.2 kg ha^{-1} at Maru when planting after December 1. Similarly, the decrease in biological yield for a one-day delay in planting after December 2 and December 1 resulted in 54.9 and 91.7 kg ha^{-1} decrease for Mushaqar and Maru, respectively.

Similar results to these findings were reported by D'Antuono *et al.* (2002) who found that total biological yield and seed yield decreased with delayed sowing, which was due to reduction in both seed number per plant and mean seed weight. Also El-Hag (1996) found that first and fifteenth of November sowing gave the highest seed yield. Ahmed *et al.* (2004) indicated that November is the best time for sowing black cumin, and Ahmed and Haque (1986) found that the highest seed yield per unit area was achieved on early sowing in November 1.

Nitrogen fertilizer rates had no effect on seed yield and biological yield at both locations except for seed yield at Maru. In this case, an increase of 20.2 % in seed yield was obtained due to fertilizer application; the absence of response to fertilizer in the study might be a result of applying nitrogen fertilizer (urea) in one dose at planting time. This was coupled with the high rainfall received during the growing season, especially at the early plant growth, there is a possibility that most of the added fertilizer was leached down and plants did not benefit from it. Therefore, a split fertilizer dose should be evaluated in future research work.

As for seed rates, no effect for this treatment was observed at the two locations, which simply indicated that the lowest seeding rate of 25 kg ha^{-1} would be appropriate and economical to be used in black cumin cultivation.

From an economic point of view, the results revealed that planting at the first date, at 25 kg ha^{-1} seed rates without adding nitrogen fertilizer would be the best combination of the three factors under the conditions of the study. However, this will depend on the status of soil nitrogen when and where the crop is to be grown.

Seed yield is strongly influenced by biological yield with r^2 value of 0.84 and 0.71 for Mushaqar and Maru locations, respectively. These values show the high level of the direct contribution of biological yield to seed yield. This is rather expected since seed yield is part of biological yield.

The most important two characters which significantly contributed to yield (seed yield and biological yield) are plant height and 1000 seed weight, whereas the contributions of the other characters are either small or negligible. Coefficient of determination (r^2) for plant height with seed yield was around 0.49 at Mushaqar and 0.29 at Maru, whereas r^2 values with biological yield were 0.72 and 0.48 for the two locations, respectively. This indicates that the size of contribution of plant height to both characters is considerably high in Mushaqar as compared to other characters.

These two traits should be considered by breeders when they develop new cultivars of black cumin with high seed and biological yield. D'Antuono *et al.* (2002) found also that seed yield of black cumin was linked to mean seed weight by positive simple correlation.

Harvest index at Mushaqar for planting date is significant, where second and third dates gave highest harvest index, which mean that 1 kg of biological yield gave more seeds and less straw, indicating that the partitioning of assimilate into seed is more efficient in late sowing. Similar results were reported by D'Antuono *et al.* (2002) who found that the harvest index of black cumin is high and showed an increasing trend in late sowing.

Weight of 1000 seed is the most important characters after plant height that affect black cumin yield. This character increased with early planting date in the two locations. Similar results were reported by D'Antuono *et al.* (2002) who found that total biological yield and seed yield decreased with delayed sowing, which was due to reduction in both seed number per plant and mean seed weight.

At Maru, the increase in plant density resulted in an increase in the weight of 1000 seed, which could be related to the competition between plants on the available soil moisture and nutrients. As a results, less number of seeds/capsules and heavier seeds were produced. While at Mushaqar, 25 and 35 kg seed ha^{-1} gave more weight of 1000 seed. Nitrogen fertilizer did not affect weight of 1000 seeds significantly at the two locations.

Plant density influenced plant height at Maru location; with increase seed rate the plant height is reduced, this may be due to mutual shading (competition for light), exhausting of the water supply (competition for water) or due to depletion of mineral nutrients. These results agreed with those reported by El-Hag (1996) who found that increasing seed rate of black cumin inversely affected plant height.

5. CONCLUSIONS

In conclusion, under the rainfed conditions of Jordan, early December planting is recommended for black cumin, because it gave the highest seed and biological yields, taller plants and heavier seeds. Twenty five kg seeds ha^{-1} (1000 plants m^{-2}) was the optimum rate under the conditions of the study. The most important traits that contributed to black cumin seed and biological yield are plant height and weight of 1000 seeds. These two characters should be considered by breeders in their attempt to develop high yielding black cumin cultivars. The results suggest that there is no need for N fertilization at Mushaqar and 20 kg ha^{-1} will be beneficial under Maru location. However, this conclusion will depend on soil nitrogen level, time and method of application of the fertilizer and the nitrogen fertilizer form.

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Table (1): Effect of planting date, nitrogen fertilizer rates and plant density on yield and harvest index of black cumin grown at Mushaqar and Maru locations during 2004/2005 season.

Location	**Mushaqar**			**Maru**		
Treatments	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
D1	954.9	5323	17.9	919.4	4158	22.3
D2	758.3	3467	21.9	748.3	2593	28.9
D3	619.7	2847	21.7	722.9	3325	21.6
LSD at 5 %	**100.4**	**483.2**	**1.92**	**NS**	**NS**	**0.46**
No fertilizer	756.7	3651	21.3	706.4	3049	23.7
20 kg N ha^{-1}	803.4	4077	20.3	848.9	3500	24.6
40 kg N ha^{-1}	772.8	3908	20.1	835.3	3528	24.6
LSD at 5 %	**NS**	**NS**	**NS**	**116.9**	**NS**	**NS**
25 kg seeds ha^{-1}	755.7	3657	20.9	814.9	3273	25.3
30 kg seeds ha^{-1}	773.6	3905	20.3	771.1	3254	24.2
35 kg seeds ha^{-1}	801.2	3986	20.8	789.0	3335	24.1
40 kg seeds ha^{-1}	780.0	3968	20.2	812.3	3574	23.4
LSD at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

D: Date of planting:

Mushaqar: D1: December 2, 2004, D2: December 30, 2004 and D3: January 17, 2005.

Maru: D1: December 1, 2004, D2: December 29, 2004 and D3: January 30, 2005.

NS: Not significant.

Harvesting Dates: Mushaqar: June 8 for the first date, and June 15 for the second and the third date.

Maru: May 30 for the first date, and June 9 for the second and the third date.

Table (2): Effect of planting dates, nitrogen fertilizer rates and plant density on yield components of black cumin grown at Mushaqar location during 2004/2005 season.

Treatments	number of branches plant^{-1}	number of capsules plant^{-1}	number of seeds capsule^{-1}	Weight of 1000 seeds (gram)	Plant height (cm)	Oil content (%)
December 2, 2004	1.34	3.7	49.9	2.78	38.7	39.5
December 30, 2004	1.40	3.4	47.2	2.64	30.8	39.9
January 17, 2005	1.51	3.7	45.3	2.54	28.2	38.4
LSD at 5 %	**NS**	**NS**	**NS**	**0.09**	**1.1**	**NS**
No fertilizer	1.43	3.7	48.0	2.65	32.4	38.7
20 kg N ha^{-1}	1.41	3.6	47.2	2.66	32.5	39.0
40 kg N ha^{-1}	1.42	3.5	47.3	2.66	32.9	39.2
LSD at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
25 kg seeds ha^{-1}	1.43	3.8	48.8	2.66	32.8	39.4
30 kg seeds ha^{-1}	1.44	3.5	48.9	2.63	32.6	38.1
35 kg seeds ha^{-1}	1.37	3.5	46.0	2.71	32.4	38.5
40 kg seeds ha^{-1}	1.44	3.5	46.3	2.63	32.6	39.7
LSD at 5 %	**NS**	**NS**	**NS**	**0.06**	**NS**	**NS**

NS: Not significant.

Table (3): Effect of planting date, nitrogen fertilizer rates and plant density on yield components of black cumin grown at Maru location during 2004/2005 season.

Treatments Planting Date	number of branches plant^{-1}	number of capsules plant^{-1}	number of seeds capsule^{-1}	Weight of 1000 seeds (gram)	Plant height (cm
December 1, 2004	2.07	5.4	59.9	2.71	31.1
December 29, 2004	1.75	4.2	57.7	2.66	25.9
January 30, 2005	1.84	4.8	54.7	2.45	28.2
LSD at 5 %	**NS**	**NS**	**NS**	**0.11**	**NS**
No fertilizer	1.86	4.6	58.7	2.56	26.4
20 kg N ha^{-1}	1.88	4.8	56.3	2.63	28.9
40 kg N ha^{-1}	1.91	4.9	57.2	2.64	29.9
LSD at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**
25 kg seeds ha^{-1}	2.11	5.1	58.5	2.54	29.1
30 kg seeds ha^{-1}	1.84	4.7	57.6	2.63	28.2

Treatments / **Planting Date**	**number of branches plant^{-1}**	**number of capsules plant^{-1}**	**number of seeds capsule^{-1}**	**Weight of 1000 seeds (gram)**	**Plant height (cm**
35 kg seeds ha^{-1}	1.79	4.8	57.6	2.65	28.1
40 kg seeds ha^{-1}	1.79	4.6	55.9	2.61	28.2
LSD at 5 %	**NS**	**NS**	**NS**	**0.07**	**0.77**

NS: Not significant.

Table (4): Days from planting to emergence, from emergence to flowering and from emergence to maturity.

location	**Mushaqar**			**Maru**		
Planting dates	Dec. 2, 2004	Dec. 30, 2004	Jan. 17, 2005	Dec. 1, 2004	Dec. 29, 2004	Jan. 30, 2005
Days from planting to emergence	33	34	35	32	33	25
Days from emergence to flowering	115	93	80	107	87	71
Days from emergence to maturity	154	130	114	145	125	104

Table (5): Coefficients of linear correlation among studied characters of black cumin grown at Mushaqar and Maru locations during 2004/2005 season.

Characters	**Seed yield**	**Biological yield**
Biological yield	0.915** (0.843**)	
Harvest index	-0.246** (0.178)	-0.604** (-0.362**)
No. of branches /plant	-0.113 (0.255**)	-0.197* (0.262**)
No. of capsules /plant	0.082 (0.311**)	0.049 (0.381**)
No. of seeds/ capsule	0.265** (0.125)	0.284** (0.079)
Weight of 1000 seeds	0.602** (0.433**)	0.599** (0.234*)
Plant height	0.703** (0.543**)	0.848** (0.691**)

*, ** significant at 5% and 1% probability levels, respectively.

Values between ( ) are for Maru.

Number of observations at each location = 108.

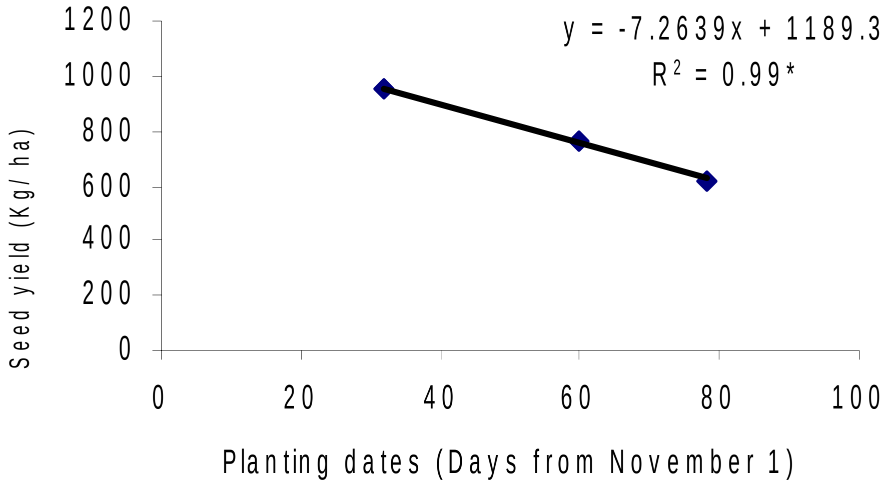

Figure (1): Relationship between planting dates and seed yield at Mushaqar location.

* = significant at 5 %.

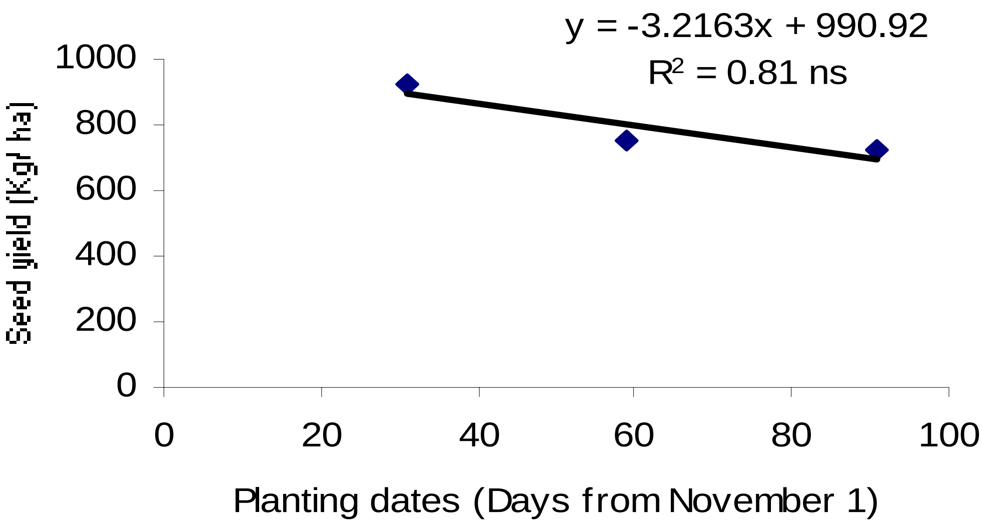

Figure (2): Relationship between planting dates and seed yield at Maru location.

ns: not significant.

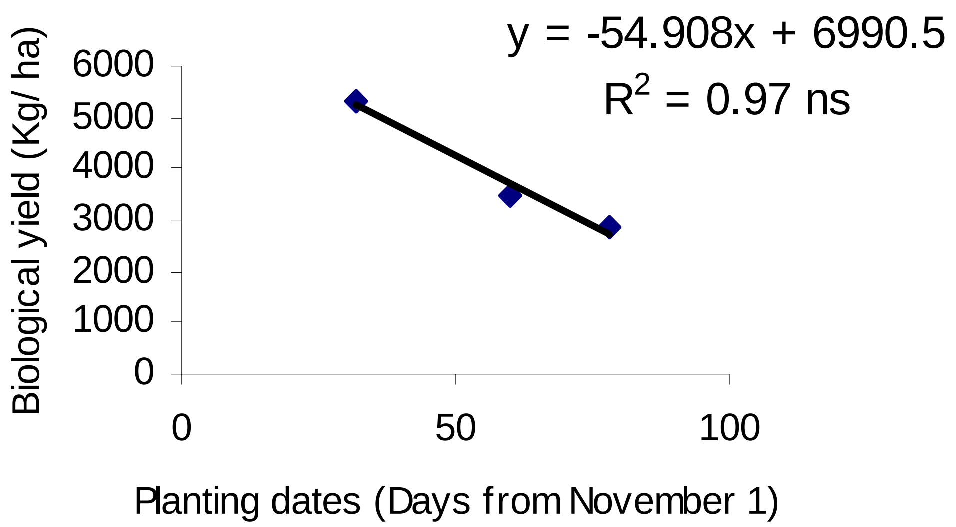

Figure (3): Relationship between planting dates and biological yield at Mushaqar location.

ns: not significant.

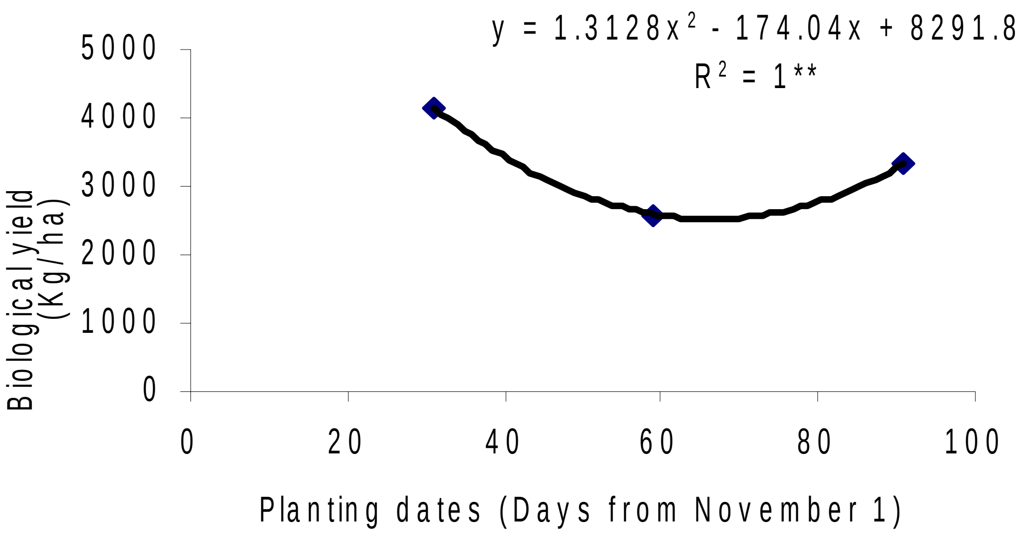

Figure (4): Relationship between planting dates and biological yield at Maru location.

** = significant at 1 %.

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أثر بعض العمليات الزراعية في نمو محصول حبة البركة وإنتاجيته تحت ظروف المناطق شبه الجافة

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ملخـص

حبة البركة نبات عشبي حولي ينتمي إلى العائلة الحوذانية، وهو غني بالقيمة الغذائية وله العديد من الاستعمالات الطبية. تهدف الدراسة الى تحديد تأثير موعد الزراعة ومعدل البذار والتسميد النيتروجيني في إنتاجية محصول حبة البركة تحت الظروف المطرية في مناطق زراعة القمح في الأردن. نفذت التجربة خلال الموسم الزراعي 2005/2004 في محطتي المشقر ومرو الزراعيتين. شملت التجربة ثلاثة مواعيد زراعة وثلاثة معدلات تسميد نيتروجيني وأربعة معدلات بذار وذلك باستعمال تصميم القطع المنشقة وتحت المنشقة العشوائية بثلاثة مكررات.

أظهرت النتائج في موقع المشقر أن الزراعة في الثاني من كانون الأول أعطت 25.1 % و 54.1 % زيادة في محصول الحب عن الزراعة في نهاية كانون الأول أو بداية كانون الثاني، على التوالي. كذلك تفوق الإنتاج البيولوجي (حب + قش) في الموعد الأول بما نسبته 53.5% و 87% عن الإنتاج في الموعدين الثاني والثالث، على التوالي. سلك دليل الحصاد مسلكا مختلفا، حيث كانت أعلى قيمة له في الموعدين الثاني والثالث وأدناها في الموعد ألأول. أما في موقع مرو، فسجلت أعلى قيمة لدليل الحصاد للموعد الثاني. تأثر وزن الألف حبة بشكل معنوي بموعد الزراعة ومعدل البذار في الموقعين. فقد كان أعلى وزن للألف حبة في المشقر تحت معدل البذار 35 كغم للهكتار تبعه معدل البذار25، 30، ومن ثم 40 كغم للهكتار. أما في موقع مرو، فكان أعلى وزن ألف حبة قد سجل بمعدل بذار 30 و35 كغم للهكتار. أعطى موعد الزراعة الأول أطول النباتات في المشقر، بينما أعطى معدل البذار 25 كغم بذور للهكتار أطول النباتات في المشقر. وكان هناك ارتباط معنوي بين طول النبات ووزن الألف حبة في الموقعين.

الكلمـات الدالـة: حبة البركة، كثافة الزراعة، مواعيد الزراعة، التسميد الآزوتي.

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