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The Effect of Three Depths of Mechanical Seed Drill (Gaspardo SC-250) on the Performance of Vicia Faba L. Bean for Yield Characteristics and Components

Murad Abdullah Abdul Qader[1], Suzan Tahseen Muhammad Amin[2]

[1]Health and Medical Technical College / Kirkuk - Northern Technical

[2]College of Agriculture/Hawija - Kirkuk University

ABSTRACT: Current study was conducted on a farm in two sites: the center of Kirkuk Governorate and Hawija District, during the 2022–2023 agricultural season. It focused on two factors: the seeding depths of the Gaspardo SC-250 machine (at 2, 3, and 6 cm) and three varieties (local, Yildiz, and Aquadulce). The land was divided according to a randomized complete block design (RCBD) according to a split-plot system with three replicates. The study allocated the sowing depth factor to the main panels and the variety factor to the secondary panels. The findings showed a notable improvement in yield characteristics and components when sowing depths were increased at both sites. It was observed that the total yield of dry seeds was significantly influenced by sowing depths at both sites, with D3 showing superior results, producing 2074.91 kg/ha and 7854.71 kg/ha, respectively. We observed that the Aquadulce variety had the highest yield rate, producing 5503.64 kg/ha and 7441.37 kg/ha, respectively. There was a significant impact of sowing depths and varieties on this trait at both sites. Specifically, at the Kirkuk site, the Aquadulce variety had the highest yield at depth D1, with 8413.83 kg/ha. At the Hawija site, the Aquadulce variety outperformed the other varieties at depth D3, yielding 9863.83 kg/ha. This superior performance was attributed to the quality of its components, resulting in a significant increase in the final yield.

KEYWORDS: Gaspardo, randomized complete block design, Aquadulce, split-plot system, variety factor

I. INTRODUCTION

Broad bean (Vicia faba L.) is an important crop in the leguminous family because its seeds contain a high percentage of protein, ranging between 23 and 45% (Stan, 1997). These seeds are used as fodder for animals, either as plant remains after harvest or as dried seeds in concentrated diets to provide protein. (Al-Fakhry, 1981). In addition, it plays an important role in improving the properties of the soil by fixing atmospheric nitrogen through the root nodule bacteria that coexist with it, and it contains quantities of sugars, starches, and some vitamins. (FAO, 2003) (Matloub et al., 1989). Several studies indicate that the Mediterranean is the origin of the bean (Sumerfield and Roberts, 1985). China is one of the largest countries when it comes to production and consumption, followed by Ethiopia. China produces 2.7 million tons of beans per year, which is 65% of global production, followed by Ethiopia at 9% and Egypt at 262,000 tons per year. In these countries, beans are consumed as a staple food for the poor (FAO, 2003). In Iraq, the production rates are low per unit area. In 2020, the total cultivated area was 12,510 acres, and the production included 10,876 tons of dry pods and 144,300 tons of green pods. The average productivity for dry pods was 869.2 kg per acre. (Central Bureau of Statistics: 2020).

Studies have indicated that depths of sowing directly affect the height and fall of the plant, as they vary according to the genetic composition of the cultivated varieties (Hasan and Abdullah, 2021). The diameter and length of the internodes in a given variety may allow for an increase in nodes and will be less affected by increased vegetation cover. Attiya et al. (1983) reported that the yield per plant decreases as sowing depths increase. Numerous studies have been carried out in this field, such as the research conducted by Kakahy et al. (2012), which examined the impact of different sowing depths on bean yield under a drip irrigation system using three varieties: Spanish, Turkish, and local. The study also looked at three planting distances of 20, 25, and 30 cm. The Spanish variety showed the highest average number of seeds per pod (3.12 seeds/pod). Yucel (2013) mentioned in his study the depths of sowing for the production of local bean varieties, and he used four local varieties and four distances of 5, 10, 15,

and 20 cm. Since a depth of 10–12 cm was shown to be optimal for crop length under such circumstances, there were no discernible variations between types with respect to yield parameters or some of their components. The impact of different planting depths on bean yield and its components was also discovered by Derogar and Mojaddam (2014). Their investigation used three different depths: 8, 12, and 16 plants/m2. The findings demonstrated that compared to other types, the Barekat cultivar produced much more seeds when planted at a depth of 12 plants/m2. The 100 seeds weighed more and the plant produced more pods as a result of this depth. Over the course of two growing seasons, researchers from the College of Agriculture at Sudan University of Science and Technology (Osman et al., 2013) examined four distinct bean cultivars. Neither the yield nor the pod density per plant varied much between the two locations. Nevertheless, there were notable variations in the amount of seeds produced per plant and the weight of 100 seeds; the Selaim variety stood out from the others in this respect.

Abbas et al. (2014) pointed out when they studied some new genetic compositions in the growth of beans and the differences in sowing depths in Egypt, where they used the varieties Assiut-159, Assiut-125, Assiut-215, Roomy-3, and Roomy-8, and their results showed that the Assiut-125 variety was superior in terms of dry seed weight, 2.1 tons/acre, whereas the Roomy-3 variety was superior in terms of the highest green yield, 10.5 tons/acre. Accordingly, this study aims at investigating the effect of three depths of mechanical seeding drill (Gaspardo SC-250) on the performance of Vicia faba L. legume varieties for yield characteristics and components.

II. MATERIALS AND METHODS

This study was conducted at two sites: the center of Kirkuk Governorate in one of the citizens' farms and Hawija district, Mahooz village, for the agricultural season 2022-2023. The study included two factors: the first was the depths of the mechanical seeding drill (Gaspardo SC-250), which were used (2–4-6 cm) and were denoted (D1, D2, and D3), respectively. The second factor is the range of varieties (local, Yildiz, and Aquadulce). The land was prepared by plowing in two perpendicular plows, then the soil was smoothed to prepare a suitable bed for the seeds, and superphosphate fertilizer was added to the soil before sowing at a rate of 70 kg. Ha-1 Al-Mayouf (1982). The land was divided into experimental units according to the randomized complete block design (RCBD) according to the split plot system with three replicates. The factor of sowing depths was distributed on the main panels and the varieties on the secondary panels, so that the number of experimental units was (9) ones. The experimental unit included 3 screws with a length of 3 m. 2-3 seeds were placed in each hole, and the distance between each hole was 25–30 cm. After the seedlings appeared, the reducing process was carried out so that each hole had one plant. Weeds were manually controlled twice during the season for both sites, and the plants were fertilized directly with urea fertilizer (44 kg/ha) in two batches: the first was after germination and the second was at the beginning of the blooming stage. (Boras et al. 2006). The irrigation process was carried out according to the plant's needs, and the following characteristics were studied: the number of pods per plant, the number of seeds per pod, the weight of 100 seeds, and the total yield of dry seeds (kg/ha) (Hasan and Abdullah, 2021).

III. STATISTICAL ANALYSIS

The data was analyzed statistically using the ready-made statistical program (SAS) to investigate the effect of sowing depths, bean varieties, and the interactions between them on the studied qualities. The least significant difference test was also used to compare the means by using the same program (SAS). (Abdullah and Hasan, 2021).

Results and discussion:

Number of pods in the plant

Table 1 shows that the number of pods in the plant at the Hawija site was not significantly affected by the sowing depths, with depth D2 reaching the highest number of pods (7.87 pods) and depth D3 having the lowest number of pods (6.77 pods). As for the Kirkuk site, the depth of sowing had a significant effect on the number of pods in the plant, as depth D3 was the highest with 15.61 pods, whereas depth D1 was the lowest depth in terms of the number of pods in the plant with 9.42 pods. The reason for this may be attributed to the ease of movement of insects and the occurrence of pollination at small depths rather than at greater depths, due to the speed of plant growth, which limits the movement of insects. Consequently, the pollination rate, particularly cross-pollination, in this crop is reduced by 42–36%. There is also competition for environmental resources among plants at the depths studied for cultivation. (Kambal, 1969) and (Younis et al., 2022) The results align with Al-Jubouri and Ali's findings in 2012, indicating that the interaction between sowing depths and varieties significantly affected the number of seeds per pod at both sites. In Kirkuk, the Aquadulce variety performed best at depth D3, producing 9.16 seeds per pod, while the

Yildiz variety had the lowest yield at the same depth, with 5.06 seeds per pod. Meanwhile, at the Hawija site, the Yildiz variety at depth D3 had the highest yield with 14.86 seeds per pod, whereas the Yildiz variety at depth D1 had the lowest yield with 7.5 seeds per pod.

Table 1: Number of seeds in the pod

The depths of the seeding machine / Varieties	Kirkuk				Hawija			
	D1	D2	D3	Rate of varieties	D1	D2	D3	Rate of varieties
Local	7.16	7.28	6.1	6.84	8.53	11.1	17.23	**12.28**
Yildiz	6.66	8.23	5.06	6.65	7.5	9.56	14.86	**10.64**
Aquadulce	8.63	8.1	9.16	8.63	12.24	12.98	14.76	**13.32**
Rate of depth	7.48	7.87	6.77		9.42	11.21	15.61	
L.S.D varieties 1.395=	**interaction L.S.D 2.245=**		**sowing L.S.D 0.915=depths**		**L.S.D interaction 0.695=**	**L.S.D sowing depths 0.283=**		**varieties L.S.D 0.404=**

Table (2) shows that sowing depths and varieties did not have a significant effect on the number of seeds per pod at the Kirkuk site. On the other hand, the Hawija site had the best D2 distance (7.11 seeds/pod) and the worst D1 depth (6.87 seeds/pod). In contrast, in the Hawija site, the pods with the most seeds per pod were found at the D3 depth (15.61), while the pods with the fewest seeds per pod were found at the D1 level (9.42). Aquadulce variants had 8.63 seeds per pod at one location and 13.32 seeds per pod at the other, demonstrating a significant variation in this attribute across the types. At both locations, the Yildiz cultivar had the fewest seeds per pod, measuring 6.65 and 10.64, respectively. This might be because this characteristic is generally fixed genetically, and it varies from variation to variety. Dahmardeh and Ramroodi (2010), Bakry et al. (2011), Hasan and Abdullah (2020), Hasan et al. (2022), Muhammad et al. (2021), and Younis et al. (2022) all agree with these findings, although Al-Jubouri (2016) disagrees.

Table 2: Weight 100 seeds/g

The depths of the seeding machine / Varieties	Kirkuk				Hawija			
	D1	D2	D3	Rate of varieties	D1	D2	D3	**Rate of varieties**
Local	6.83	6.97	5.25	6.35	6	5.74	4.96	**5.56**
Yildiz	7.34	6.68	7.27	7.09	5.23	6.32	4.97	**5.50**
Aquadulce	6.29	7.68	8.11	7.36	5.21	5.87	5.77	**5.61**
Rate of depth	6.82	7.11	6.87		5.48	5.97	5.23	
L.S.D varieties =0.142	L.S.D sowing depth=0.097		L.S.D interaction =0.265		L.S.D varieties =0.187	L.S.D sowing depths =0.154		**L.S.D interaction =0.312**

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The interaction between sowing depths and varieties significantly affected the number of seeds per pod at both sites. At the Kirkuk site, the Aquadulce variety had the highest number of seeds per pod at depth D3, with 8.11 seeds per pod, while the local variety at the same depth had the lowest at 5.25 seeds per pod. At the Hawija site, the Yildiz variety at depth D1 had the highest number of seeds per pod at 6.32, whereas the Aquadulce variety had the lowest at 5.21 seeds per pod at the same depth.
Table (2) The effect of sowing depths, varieties, and the interaction between them on the number of seeds per pod in the two sites.

It is revealed from the results in Table (3) that increasing sowing depths did not significantly affect the weight of 100 seeds at the Kirkuk site. However, at the Hawija site, sowing depths were significantly affected, as Depth D3 had the highest weight for the 100 seeds, reaching 105.49 grams, while Depth 2D had the lowest values at 97.38 grams. Also, the Aquadulce type did far better at both locations; its average weight was 109.16 grammes at the first site and 110.38 grammes at the second. Out of the two locations, the Yildiz variety had the lightest 100-seed weight at 93.83 g, 109.16 g, and 99.38 g, respectively.

. The reason for this may be attributed to the small number of plants due to uneven growth as a result of the great depth, which leads to reducing competition for food by the farmers, causing a high deposition of nutrients in the seeds. Moreover, increasing the depth among plants leads to reducing the efficiency of light interception of sunlight and increasing the efficiency of photosynthesis (Thalji, 2006; Abdullah and Hasan, 2021). It is also noted that the interaction between sowing depths and varieties was significant in terms of seed weight for both sites. At the Kirkuk site, the local variety at depth D1 had the highest rate, amounting to 115.5 g, whereas the local variety was the lowest at depth D2, as it had 84.83 g. At the Hawija site, the local variety at depth D3 had the highest average weight of 100 seeds, which amounted to 125.83 grams. On the other hand, the Yildiz variety was the lowest at depth D1, weighing 84.5 grams. The result agrees with Hasan and Abdullah (2020), Hasan et al. (2022), Muhammad et al. (2021), and Younis et al. (2022).
Table (3) The effect of sowing depths, varieties, and the interaction between them on the weight of (100) seeds/g of dry seeds in the two study sites.

Table 3: Total yield (kg/ha)

The depths of the seeding machine / Varieties	**Kirkuk**				**Hawija**			
	D1	D2	D3	Rate of varieties	D1	D2	D3	**Rate of varieties**
Local	115.5	84.83	110.83	103.72	103.83	99.83	125.83	109.83
Yildiz	89.5	98.83	93.16	93.83	84.5	113.83	99.83	99.38
Aquadulce	106.5	108.5	112.5	109.16	119.16	104.16	107.83	110.38
Rate of depth	103.83	97.38	105.49		102.49	105.94	111.16	
L.S.D varieties =2.125	L.S.D interaction =3.512		L.S.D sowing depths =1.421		L.S.D interaction =3.426	L.S.D sowing depths=1.382		L.S.D varieties =1.943

Table (4) shows that the total yield of dry seeds was significantly affected by the sowing depths. In both sites, the depth D3 exceeded the total yield of dry seeds (kg/ha), as it had (2074.91 kg/ha) and (7854.71 kg/ha), respectively. The depth D2, on the other hand, had the lowest rate at (4401.83 kg/ha) and (4547.35 kg/ha), respectively. There might be a correlation between the number of branches per unit area and the increase in the total yield at short distances. This helps in producing more pods, which reflects positively on the yield, especially if the nutrients are sufficiently available to the plant. (Chaieb et al., 2011).
It is noted from Table (4) that the average total yield of dry seeds varies according to the varieties studied. The differences among the varieties were significant, with the Aquadulce variety giving the highest rate of 5503.64 kg/ha and 7441.37 kg/ha, respectively. However, the Yildiz variety had the lowest rates of 3595.78 kg/ha and 4972.29 kg/ha, respectively. The reason for this discrepancy among varieties is attributed to their various genetic structures. Table 4 also shows a significant effect of the interaction of sowing depths and varieties on the average of this characteristic in both sites. It is noted at the Kirkuk site that the Aquadulce variety had the highest rate of this characteristic at depth D1, amounting to 8413.83 kg/ha, whereas the local variety at depth D3 had the lowest rate of total dry seed yield, amounting to 1417.13 kg/ha. As for the Hawija site, the Aquadulce

variety outperformed the rest of the varieties in this characteristic at depth D3, reaching (9863.83 kg/ha), whereas the Yildiz variety was the lowest in this average at depth D2, reaching (3812.16 kg/ha).

Table 4: Sowing depths, varieties, and the interaction between them for the total yield (kg/ha) of seeds in the two sites

The depths of the seeding machine / Varieties	Kirkuk				Hawija			
	D1	D2	D3	Rate of varieties	D1	D2	D3	Rate of varieties
Local	5617.16	5275.83	1417.13	4103.37	4121.5	4022.7	7075.16	5073.12
Yildiz	6147.16	2820.83	1819.36	3595.78	3812.16	4479.56	6625.16	4972.29
Aquadulce	8413.83	5108.83	2988.26	5503.64	7320.5	5139.8	9863.83	7441.37
Rate of depth	6726.05	4401.83	2074.91		5084.72	4547.35	7854.71	
L.S.D varieties =122.301	L.S.D interaction =211.830		L.S.D sowing depths=86.478		L.S.D interaction =666.084	L.S.D sowing depths =271.927		L.S.D varieties 384.563

IV. CONCLUSIONS

According to the results revealed, it was shown that D3 and the Aquadulce variety were superior in all the studied characteristics in comparison to other varieties for both sites. After conducting numerous studies in different locations and seasons, it is possible to benefit from this genetic composition because Aquadulce possesses the majority of the studied characteristics. This genetic composition can then be used in hybridization programs with other varieties in order to transfer desirable genes to other varieties. Additionally, a number of genetic tests were carried out on this variety to ascertain the degree of its resistance to various environmental conditions.

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