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Original Research

Effect of spraying a nutritional, hormonal mixture to reduce the phenomenon of flowering fall in broad bean varieties (*Vicia faba* L.)

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ABSTRACT:

A field experiment was carried out during the agricultural season 2016/2017 in Al-Rumaitha region, 25 km north of Al-Muthanna province, in order to study the effect of spraying a nutritional hormonal mixture to reduce the phenomenon of flowering fall in the yield of broad bean varieties. The experiment was arranged in a split plot design, where the main plot treatments included three varieties (Luz De Otono, Aquadlegi and Aquadolus), whereas the mixture spraying treatments (M_0, M_1 and M_2) were placed in sub plot by using a randomized complete block design with three replications. The results showed that adding the highest concentration of the mixture (M_2) in the spraying solution resulted to an increase in the plant height, the branches number, the leaf area and leaf area index compared to the non-spraying. The highest concentration of the mixture (M_2) resulted also increased in the effective fertilization rate (53%), number of pods per plant (21%) and the total seed yield (15%) compared to non-spraying. There were no significant differences between the spraying treatments and the non-spraying of the mixture in number of seeds per pod and the weight of 100 seeds. The results showed that the differences between the varieties were significant in most of the studied traits. Aquadolus variety were superior in all the studied growth traits compared to the other two varieties, while Luz De Otono variety gave the highest percentage of fertilization and number of pods per plant, while the superiority of the Acidos variety in number of seeds per pods trait. The interaction between spraying with a hormonal and nutritive mixture showed significant effect on most studied traits, the combination of the highest concentration of the mixture and aquadolus variety ($V_3 \times M_2$) gave the best seed yield of 5735 Kg. ha^{-1}, while the combination of the highest concentration of the mixture and Luz De Otono variety ($M_2 \times V_1$) gave the best effective fertilization rate (19.80%).

Keywords:
Nutritional hormonal, Broad bean, Nutrient solution, varieties.

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INTRODUCTION

Broad bean *(Vicia faba* L.) is an important seed crop that is a staple food for millions of poor people because it has a high protein content of 23-37% (Alghamdi, 2009), as well as containing the seeds in most varieties the carbohydrates amounting to 48-54% and fiber and mineral elements and vitamins such as Thiamine and Riboflavin and vitamin C (Natalia *et al*., 2008).

There are many problems that reduce the productivity of the brad bean but the phenomenon of flowering fall and ovules abortion is the most important problem and can occur this phenomenon due to competition between the vegetative and reproductive parts on some photosynthesis products or between the reproductive parts with each other, this competition affects plant hormones directly or indirectly and because hormonal imbalance is one of the factors affecting the occurrence of separation and flowering fall) Patrick and Stoddard, 2009).

Decreasing of Indole Acetic Acid (IAA) leads to increased flowering, continuous in IAA production helps to reduce flowering fall because of the fruit set need a hormone tonic obtained from either the pollen, which is a rich source of auxins or the amino acid Tryptophan, which transforms to the IAA, which helps to delay the flowering fall as it contributes to the increased probability of fertilization and flower set naturally (Hussein, 2011**)**, or the flowering fall may occur diminution in availability of some essential nutrients of the plant which have a key role in the stages of growth and reproduction and decrease of these nutrients affects the flower activity as a boron, phosphorus and potassium, which play an important role in fertilization and pods set, (Doorn and Stead*,* 1997), and it is also important to expand the cultivation of the others and raise their productivity is to cultivate highly productive varieties and to follow effective field methods to obtain the potential of these varieties and to know their adaptability to local conditions (Jabouri *et al.*, 2001). Based on the reasons given for flowering, this experiment was carried out with the aim of identifying the response of many varieties of broad bean by spraying the plants with a nutritional hormonal mixture for the purpose of reducing flowering fall and improving production.

MATERIALS AND METHODS

A field experiment was carried out during the agricultural season 2016/2017 in the field of one of the farmers in Al-Rumaitha region of Al-Muthanna province. The study was conducted to study the effect of spraying with a hormonal nutritional mixture on the growth and yield of broad bean varieties. The experiment was applied according to the split plot design, a main plot included the varieties, whereas the mixture spraying treatments were placed in sub plot by using the Randomized Complete Block Design (RCBD) with three replications. The tillage, harrowing and leveling were carried out. The field was divided according to the design used. The field of experiment was then done by cultivation in lines, (60 cm) between one line and another, the experimental unit ($2.4\times3=7.2$ m^2) has four lines with a length of three meters per line and planted the seeds of the others with a distance of 20 cm the between hill and another two seeds in hill and then reduced to one plant in hill, with the plant density of 83.333 ($plant.ha^{-1}$) (Al-Qatrani, 2016).

The seeds were planted on 14 October and nitrogen fertilization was carried out with 80 kg $N.ha^{-1}$ in the form of urea fertilizer (46% N) and at one time after planting (15 days). The phosphate fertilization was 80 kg $P_2O_5.ha^{-1}$ in the form of super fertilizer phosphate triphosphate (21% Phosphorous) and potassium fertilizer in the amount of 80 kg K_2O (Potassium Oxide) in the form of potassium sulphate (48% K) once before agriculture (Abedi, 2011) irrigation and weeding operations were also carried out as needed. Spraying was done after preparation of the concentrations used in the mix-

Table 1. Some physical and chemical characteristics of the experiment field before planting

S. No	Attribute		Value	Unit
1	pH		7.2	
2	Electrical conductivity		5.8	Desimines M^{-1}
3	Cation exchange capacity		24.8	cm (+) kg^{-1}
4	Nitrogen ready		21	$mg.kg^{-1}$ soil
5	Phosphorus ready		6	$mg.kg^{-1}$ soil
6	Potassium ready		160	$mg.kg^{-1}$ soil
7	Analysis of minute volumes	Sand	253	$mg.kg^{-1}$
		Gluten	431	
		Clay	316	
8	Tissue		Mixture of clay	

ture spray solution and on the basis of the amount of water (400 liters.ha^{-1}). The mixture was sprayed in two stages at the beginning of the flowering and the second when the plants reached 50% flowering. At each stage, the concentration was added in full to each spray, taking into account the spraying times in the morning or evening to avoid high temperatures, dispersing and wetting agents were added to the nutrient solution for reducing the surface tension of the water and to ensure complete wetness of the leaves in order to increase the efficiency of the spray solution.

Random samples were taken from different places of each replicator and mixed together to take a composite sample representing the experiment field and depth (0-30 cm). A physical and chemical analyzes were carried out for the experimental field before planting, as shown in (Table 1).

Experimental treatments

The first factor: Three varieties of broad bean approved by the National Committee for the registration, certification and protection of agricultural varieties in 2014: (Luz De Otono: V_1, Aquedge: V_2 and Aquadolus: V3).

The second factor: Preparation of a mixture in the laboratory of graduate studies in agriculture faculty, Al-Muthanna University, consisting of nutrients and hormones to increase the plant fertility and reduce the fall of flowers, this factor is sprayed from three concentrations of the mixture as follows:

1. Comparative treatment (spraying with distilled water only) and symbolize M_0.

2. The first concentration of the mixture and its symbol is M_1, which is composed of boron with a concentration of 50 $mg.L^{-1}$, Auxins at a concentration of 20 $mg.L^{-1}$,

Table 2. Effect of spraying of hormonal and nutritional mixtures and varieties and their overlap in the number of days of planting up to 50%

S. No	Mixtures Varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	62.89	62.33	91.89	72.37
2	M_1	63.00	62.44	93.00	72.81
3	M_2	63.89	63.44	94.00	73.78
4	Rate varieties	63.26	62.74	92.96	
5	L.S.D	varieties	mixtures	V × M	
		2.67	1.10	N.S	

Table 3. Effect of spraying hormonal nutrient mixtures and varieties and their interaction in plant height (cm)

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	75.12	69.94	89.56	78.21
2	M_1	73.03	74.18	91.90	79.70
3	M_2	73.84	74.31	103.43	83.86
4	Rate varieties	74.00	72.81	94.96	
6	L.S.D	varieties	mixtures	V × M	
		6.66	3.16	7.07	

phosphorus with a concentration of 1000 mg.L^{-1} and potassium with a concentration of 2000 mg.L^{-1}.

3. The third concentration of the mixture and its symbol is M_2, which is composed of boron with a concentration of 100 mg.L^{-1}, auxins, with a concentration of 40 mg.L^{-1}, phosphorus with a concentration of 2000 mg.$L^{-1}$and potassium with a concentration of 4000 mg. L^{-1}.

Traits studied

1. The number of days from planting to 50% flowering: Calculated on the basis of field viewing (Jabouri *et al*., 2001).

2. Plant height (cm): 10 plants were taken from each experimental unit and were measured before one week of harvest.

3. The number of branches in the plant: 10 plants of each experimental unit was taken and measured before the week of harvest.

4. Leaf area: The leaf area of each plant was measured with the stage full of pods by a leaf area device (Jabouri *et al*., 2001).

5. Leaf area index: Leaf area index was calculated according to the following equation: Leaf area index = leaf area / area occupied by one plant.

6. Effective fertilization percentage was calculated according to the equation below: Effective fertilization ratio = pods number per plant/ total number of flowers per plant x 100.

7. Pods number in plant: Calculated in the maturity stage as an average of ten plants per experimental unit (Al-Qatrani, 2016).

8. Number of seeds per pods: 25 pods were taken randomly after the harvest for each experimental unit and the number of seeds were calculated It was then extracted from the average number of seeds in pods (Al-Qatrani, 2016).

Table 4. Effect of spraying hormonal and nutritional mixture and varieties in the number of branches

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	7.24	6.60	10.17	8.00
2	M_1	7.03	7.38	10.31	8.24
3	M_2	7.45	7.29	11.59	8.78
4	Rate varieties	7.24	7.09	10.69	
5	L.S.D	varieties	mixtures	V × M	
		0.81	0.39	0.87	

Table 5. Effect of spraying hormonal and nutritional mixture and varieties in the paper area ($cm^2.plant^{-1}$)

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	3989	3770	5687	4482
2	M_1	4511	4448	6637	5199
3	M_2	4877	4655	6706	5413
4	Rate varieties	4459	4291	6343	
5	L.S.D	varieties	mixtures	V × M	
		174.7	149.1	N.S	

9. Weight of 100 seeds (g): After the harvest and drying of the seeds well, a random sample of 100 seeds were taken per unit experimental area and weighed with a sensitive balance (Jabouri *et al*., 2001).

10. Total seed yield ($kg.ha^{-1}$): The harvest was done after the emergence of signs of maturity and after the seeds were screened, cleaned, purified, and then dried seeds were calculated on the basis of the moisture (15%.)

Statistical analysis

The data were statistically analyzed according to the design used in the experiment using the GenStat analysis program, Release 17 Arithmetic means were compared according to the L.S.D test under a probabilistic level of (5%) (Al-Rawi and Khalaf Allah, 2000).

RESULTS AND DISCUSSION

Number of days of planting to 50% flowering

The results in Table 2 showed a significant increase in the number of days from planting to flowering 50% with a higher concentration of the mixture in the spray solution. The highest concentration of M_2 gave the highest mean of 73.78 days which differed significantly from the non-spray treatment M_0 which gave a mean average of 72.37 days (the lowest mean) this may be due to the fact that auxin helps to delay the leaves senescence, as well as to delay the maturation of the fruits, which contributed to increase the number of days to 50% flowering, this result is in agreement with Hazili and Jubouri (2016). The results showed that Aquadolus variety recorded the longest period of the number of days to flowering 50% and gave a mean of 92.96 days and a significant difference from the other two varieties which did not differ significantly between them and gave lowest mean of this trait 62.74 and 63.26 days respectively (Table 2), This may be due to the difference in the genetic structure of the varieties in terms of their needs for the combined thermal units needed to the tran-

Table 6. Effect of spraying hormonal and nutritional mixture and varieties in the leaf area index

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	3.32	3.14	4.74	3.73
2	M_1	3.81	3.70	5.53	4.35
3	M_2	4.06	3.87	5.59	4.51
4	Rate varieties	3.73	3.57	5.28	
5	L.S.D	varieties	mixtures	V × M	
		0.14	0.12	N.S	

Table 7. Effect of spraying hormonal and nutritional mixture and varieties in the effective fertility rate (%)

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	12.01	11.60	11.41	11.67
2	M_1	17.13	16.07	13.68	15.63
3	M_2	19.80	17.66	16.02	17.83
4	Rate varieties	16.31	15.11	13.70	
5	L.S.D	varieties 0.70	mixtures 0.43	V × M 0.82	

sition of the flowering stage. This result was consistent with the findings of Al-Tawki (2015), which showed significant differences between the variety in this trait.

Plant height (cm)

The results showed that spraying of the mixture at the highest concentration M_2 led to an increase in plant height, which gave a mean of 83.86 cm and a significant difference from the control treatment M_0, which gave the lowest mean of 78.21 cm (Table 3), It is believed that the reason of increased plant height with increased mixture concentration may be due to the positive role and vitality of the nutrients and hormones that form the mixture, which contribute to increase the efficiency of the photosynthesis and the transfer of its products from the source to the active areas (sink) in the plant, which led to increase the plant growth generally, such as the plant highest, and this result was in agreement with Nosser (2011) and Hazili and Jubouri (2016). aquadolus also recorded the highest mean height of 94.96 cm, with a significant difference between the two cultivars, Aquadlegi and Luz De Otono, which did not differ significantly between them and gave the lowest mean in plant heights at 72.81 and 74.00 cm respectively (Table 3). This may be due to the suitability of environmental conditions in the region of aquadolus and the nature of its genetic structure. This finding was consistent with the findings of Al-Tawki (2015) and Al-Moussawi (2017), who showed significant differences between the cultivars in plant height. Concerning the effect of interactions between the mixture and the varieties was significantly affected by this effect, the highest concentration of the mixture (M_2) with Aquadols (V_3) gave the highest mean of 103.43 cm, while the non-spray with the mixture (M_0) was given with Aquadlegi (V_2), the lowest mean in plant height of 69.94 cm (Table 3).

Number of plant branches (Branch. plant^{-1})

The results indicated that spraying of the mixture at the highest concentration M_2 resulted in an increase in the branches number of the plant, which gave

Table 8. Effect of spraying hormonal and nutritional mixture and varieties in the number of pod in plant

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	13.43	13.88	12.89	13.40
2	M_1	14.97	15.88	13.78	14.87
3	M_2	17.29	16.21	15.46	16.32
4	Rate varieties	15.23	15.32	14.04	
5	L.S.D	varieties 0.89	mixtures 0.42	V × M 0.95	

Table 9. Effect of spraying hormonal and nutritional mixture and varieties in the number of seeds /pod

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	4.85	4.76	5.22	4.94
2	M_1	4.76	4.96	5.20	4.97
3	M_2	5.00	4.92	5.50	5.14
4	Rate varieties	4.87	4.88	5.31	
5	L.S.D	varieties	mixtures	V × M	
		0.22	N.S	N.S	

mean of 8.78 branches per plant and a significant difference of control treatment M_0, which gave a least mean of 8.00 branch per plant (Table 4). This may be due to the role of the nutrients that constitute the mixture in many plant physiological processes, which in turn lead to increase vegetative growth of the plants, including the number of branches, this result was in agreement with (Jasim *et al.*, 2016), indicated an increase in the number of plant branches when spraying with phosphorus and potassium.

The results showed that aquadolus variety showed significant superiority in the number of branches in the plant and gave the mean highest of 10.69 branches per plant with an increased rate of 47% of two varieties (Luz De Otono and Aquadlegi), which did not differ significantly between them and gave the least mean of 7.09 and 7.24 plant respectively (Table 4). The difference in the number of plant varieties in the number of plant branches may be due to the nature of the genetic variety and their ability to exploit the growth factors and to respond to the environmental factors prevailing in the region, this result was in agreement with Al-Shamma (2014) and Thalji (2015) who showed that the different varieties differed significantly in the number of plant branches.

The interaction between the mixture and the varieties were significant in the number of branches in the plant, the plants of aquadolus variety V_3, which were sprayed with the highest concentration of the M_2 mixture ($V_3 \times M_2$), gave the highest mean of 11.59 branch per plant, while the plants of aquadlegi variety V_2 with the control treatment gave the lowest mean in number of branches in the plant of 6.60 branch plant (Table 4).

Leaf area (cm^2)

Effect of spraying the mixture significantly in the leaf area, where the highest concentration of M_2 in giving the highest mean of leaf area was 5413 cm^2 per plant, while the non-spray treatment M_0 gave the lowest mean of 4448 cm^2 per plant (Table 5), these results were in agreement with Mahdy and Abd El-Rheem (2015) and Zubaidi and Alwan (2015). The results in Table 5

Table 10. Effect of spraying hormonal and nutritional mixture and varieties in the 100 seed weight (g)

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	132.72	126.97	137.21	132.30
2	M_1	129.34	130.46	134.62	131.47
3	M_2	130.76	126.16	137.96	131.63
4	Rate varieties	130.94	127.87	136.60	
5	L.S.D	varieties	mixtures	V × M	
		N.S	N.S	N.S	

Table 11. Effect of spraying hormonal and nutritional mixture and varieties in the total seed yield (kg ha^{-1})

S. No	Mixtures varieties	Varieties (V)			Mixtures rate
		V_1	V_2	V_3	
1	M_0	4329	3957	4616	4301
2	M_1	3975	4497	5003	4492
3	M_2	4461	4642	5735	4946
4	Rate varieties	4255	4366	5118	
5	L.S.D	varieties	mixtures		V × M
		N.S	250.2		958.5

showed the significant effect of the varieties and the highest mean in leaf area was 6343 cm^2.plant^{-1}, while Aquadlegi variety gave the lowest yield was 4291 cm^2.plant^{-1}, these results were in agreement with the findings of Kubure *et al*. (2015) and Moussawi (2017). The highest concentration of M_2 and aquadolus may be due to their superiority in plant height Table 3, and the number of branches in the plant Table 4, which contributed to the reception of a greater amount of light and led to increase of photosynthesis in the plant and the consequent increase in the number of leaves in the plant and thus increase the leaf area.

Leaf area index

The results in Table 6 indicate a significant increase in this effect with an increase of spray concentrations in the mixture. The highest concentration of the M_2 mixture achieved the highest mean of the leaf area index of 4.51 while the non-spray treatment M_0 gave the lowest mean of 3.32, these results were consistent with the results indicated by Hussein (2011) and Mahdy and Abd Ek-Rheem (2015). The results in Table 6 indicate also that there are significant differences between the varieties in this trait, aquadolus variety achieved the highest mean of the leaf area index of 5.28, while Aquadlegi variety registered the least mean of this trait, these findings were consistent with findings of Sahib (2012) and Al-Shamma (2014). The higher concentration of mixture M2 and aquadolus variety may be due to their superiority in the leaf area Table 5, which is reflected in the leaf area index trait because there is a correlation between them.

Effective fertility rate%

It is clear from Table 7 that spraying with the mixture resulted in a significant increase in the percentage of fertilization and reached the highest mean 17.83% at the highest concentration (M_2) and an increase of 53% from the control treatment (M_0), which gave 11.67%, which decreased to 34% of the second concentration (M_1), which gave a fertile rate of 15.63%, this may be due to the important role of foliar nutrient (phosphorus, potassium, boron) and plant hormones (auxins) in stimulating many vital processes and their role in flowering and the flowers set, as well as increase in the rate of germination and stability of pollen, which reduce the ovules abortion and then contributes to increased fertilization and thus increasing the flower set.

The fertility rate in flowering is affected by many factors, some of which are related to nutrition and others are genetic factors (Barker and Pilbeam, 2006). This finding was consistent with that found by Allak (2015) and Zubaidi and Alwan (2015).

The varieties differed significantly between them and gave Luz De Otono variety the highest fertility rate of 16.31%, then Aquadlegi variety (V_2) which gave a fertility rate of 15.11%, which significantly exceeded aquadolus (V_3), which gave the lowest fertility rate of 13.70% (Table 7), then Aquadlegi variety (V_2) which gave a fertility rate of 15.11%, with significant superiority on aquadolus variety (V_3), that gave the lowest fertility rate of 13.70% (Table 7). The low fertility

rate of aquadolus variety may be due to an increase in the number of days of planting up to 50% (Table 2) and then maturity compared to the other two varieties, this affected the fruit set and thus reduced fertility rate, as a result of exposure to a longer period of changing environmental conditions, or may be due to different varieties in their genetic nature and their varying efficiency in converting photosynthesis products to flowering for increasing the rate of fertilization and flower set, and this result was in agreement with Hussein (2011) and disagreed with the results of Moussawi (2017) which indicated that there is no significant difference between varieties in the effective fertilization rate.

Interaction between the mixture and the varieties resulted in a significant effect on the fertilization ratio. The highest concentration of the mixture M_2 with Luz De Otono variety (V_1), combination of the highest concentration of the M2 mixture with Luz De Otono variety (V_1) combination of ($M_2 \times V_1$) gave the highest mean of this characteristic at 19.80%, while the non-sprayed mixture M_0 with aquadolus variety (V_3), combination ($V_3 \times M_0$) gave the least mean in the fertilization rate of 11.41% (Table 7).

Number of pods in the plant (Pods.plant^{-1})

The results indicated in Table 8 showed a significant effect of the mixture on the increase in the number of pods in the plant, the highest concentration (M_2) gave the highest mean of the trait and was 16.32 pods.plant^{-1} and a 21% increase compared to the comparison treatment (M_0), which gave the lowest mean of pods number in the plant amounted to 13.40 pods.plant^{-1}, which decreased to 9% from the second concentration of the mixture (M_1), which gave 14.87 pods.plant^{-1}, this may be due to the improvement in growth characteristics, especially the period of flowering (Table 2).

The plant leaf area (Table 5) and leaf area index (Table 6), which means prolonging the duration and efficiency of photosynthesis, increases the production of dry weight, which reduced the state of competition within the plant and helped to increase the pods number. This is due to the role of the mixture in supplying the plant with essential nutrients, especially phosphorus, potassium and boron, and the addition of auxins in achieving the hormonal balance, which serves to increase the pods number in the plant by improving the fertility rate (Table 7). This result was in agreement with Nosser (2011) and Khattab *et al.* (2016).

The results of Table 8 indicate that there is a significant difference between the varieties in increasing the pods number in the plant, the Aquadlegi variety (V_2) achieved the highest rate of this characteristic was 15.32 pods.plant^{-1}, which did not differ significantly from Luz De Otono variety (V_1), which gave a mean of 15.23 pods.plant^{-1}, while aquadolus variety (V_3) gave the lowest rate of the pods number in the plant was 14.04 pod.plant^{-1}, this may be due to the superiority of these two varieties in the fertilization ratio (Table 7). This result was consistent with what was indicated by Sahib (2012) and Negash *et al.* (2015).

There was also a significant effect of the interaction between the mixture and varieties in the pods number in the plant, the highest concentration of the mixture (M_2) with Luz De Otono variety (V_1) showed a higher mean of 17.29 pod.plant^{-1}, while non-sprayed by mixture (M_0) with aquadolus variety (V_3) gave the lowest mean in pods number per plant at 12.89 pod.plant^{-1} (Table 8).

Number of seeds in pods (seed.pod^{-1})

The results of the statistical analysis showed the significant effect of the varieties only in the number of seeds in the pod. The results in Table 9 showed the significant effect of the varieties in the seeds number in the pod, and significant superiority of aquadolus variety (V_3) was observed with an increase of 9% on the Luz De Otono (V_1) and Aquadlegi (V_2) varieties, which did not differ significantly between them, with a mean of 5.31, 4.87 and 4.88 seed. pod^{-1} respectively.

Weight 100 seed (g)

The results of the statistical analysis in Table 10 indicate the absence of the significant effect of the mixture and the varieties and the interaction between them in this trait.

Total seed yield (kg.ha^{-1})

The seed yield was significantly increased with the concentration of the mixture increased in the spray solution in Table 11. The highest concentration (M_2) gave the highest mean of seed yield of 4946 kg.ha^{-1}, thus recording a significant superiority over the M0 and M_1 concentrations, which gave the lowest average of 4301 and 4492 kg.ha^{-1} respectively. This may be due to the increase in leaf area and in leaf area index (Table 5 and 6). The effective fertilization rate Table 7 and the increase in the pods number in the plant (Table 8). This result was consistent with the results of (Hussein, 2011) and (Jasim *et al*., 2016). Interaction between the mixture and the varieties also had a significant effect on the increase in the total seed yield. The high concentration of the mixture with aquadolus variety ($M_2 \times V_3$) on all other combinations gave the highest mean of this trait of 5735 kg.ha^{-1}.

The result of this interaction showed the positive role of the high concentration of the mixture in providing the photosynthesis products at sufficient quantities and thus affecting the plants of aquadolus variety, which exploited their physiological and genetic abilities with high efficiency, that resulted in an increase in seeds yield due to the increase in the seeds number in pods (Table 9), and the weight of 100 seeds (Table 10). Although this increase was insignificant, but its effect was cumulative, which resulted in a significant increase in the seed yield, while the combination between the control treatment and the Aquadlegi variety ($V_2 \times M_0$) gave the lowest mean of seed yield of 3957 kg.ha^{-1} (Table 11).

CONCLUSION

1. Total seed yield was increased by 15% when spraying with the highest concentration of the M_2 mixture compared to the non-spray treatment due to the increase in fertilization, which led to the increase in the number of pods.
2. The aquadolus recorded a significant increase in all growth characteristics and the number of seeds by cornea compared to the other two varieties. While the class Luz De Otono gave the highest percentage of fertilization and the number of pods in the plant.
3. The reaction of the varieties of the mixture spray was significant in most of the traits of growth, fertilization rate and seed yield. The combination ($M_2 \times V_3$) gave the highest average seed yield of 5735 kg.h^{-1}.

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