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FIELD EVALUATION OF WHEAT SEEDER MACHINE

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ABSTRACT

The experiment was carried out at the farm of the Faculty of Agriculture and Veterinary Medicine, Thamar University, Dhamar Governorate to study the performance field evaluation of wheat seeder machine (Gaspardo No 0709). Three factors were selected for this research they are forward speed (2.02-2.05, 3.7- 3.80 and 3.91- 4.05km/h), three weight of grain (2, 3 and 4 kg) and tow sowing rate (20 and 40 kg/ha).The experimental data were analyzed using analysis of variance (ANOVA). The means were compared with LSD at 5% level significance for all study parameters. This analysis was performed by Statistical Analysis SAS program. The results showed that the largest discharge rates were found to be 168.03, 108.54 and 111.25 g for the discharge opening 40 kg, speed 3.91-4.05 km / h and seed quantity 2 kg, respectively. The largest mean number of plants / 1 meter length was 54.778, 49.6459 and 52,458 for the discharge opening 40 kg, speed 3.91 - 4.05 km / h and seed quantity 2 kg, respectively. The largest mean of plant density (plant / m^2) was 219.11, 197.00 and 209.83 plants / square meter for discharge opening 40 kg, speed 3.91 - 4.05 km / h and seed quantity 2 kg, respectively. The results showed that the discharge opening (40 kg / ha x 6 boxes) was significantly superior by giving it the highest rate of discharge, as the highest values were attained for the two studied traits (number of plants in 1 meter length and the value of plant density) compared to the discharge opening 20 kg / ha x 6 boxes). While the difference in speed, did not have a significant effect on the rate of seed discharge for all studied traits. Also, the quantity of seeds (2) kg achieved the highest rate of discharge, and the highest values at the two studied traits compared to the quantities (3 and 4) kg. The obtained results recommended using discharge opening 40 kg, speed 3.91 - 4.05 km / h and the quantity of seeds (2) kg.

Keywords: Discharge opening, Evaluation, Field, Seed quantity, Wheat seeder

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1. INTRODUCTION

Wheat crop is considered one of the most important economic and strategic grain crops and the main food crop for humans in most countries of the world, as wheat production in the world for the year 2010 is about (650.9 million tons) to be cultivated with an area of (217 million hectares) and with an average productivity of about (92.9 tons / hectare) (FAO, 2010). In Yemen wheat cultivated area decreased from 138.3 thousand hectares in year 2010 to 74.850 thousand hectares in 2015. Also the production and the productivity rate decreased from 250.2 tons and 1.81 tons/ha to 124.940 thousand tons and 1.67 tons/ha in 2015. The reason for this decrease may be due to the lack of rain, the scarcity of ground water, the pulse of water, springs and wells in addition to the architectural expansion in the bottoms and valleys. Production is mainly concentrated in Al Jawf Governorate, which produces 21.6%, followed by Dhamar Governorate 20.2%, and Sana'a 19.2 %, Ibb 12.7%, Hadramaut 8.7%, Ma'rib 8%, and the rest of the governorates produce about 9.6% (Agricultural Statistics Book, 2012 and 2015).Manual cultivation, which constitutes a problem in organizing seed distribution, which leads to the heterogeneity of plant density in the field, and the inability of manual cultivation to standardize the appropriate depth to place the seeds, as the agriculture needs additional operations such as the seed covering process, compared to the use of mechanical cultivation. In manual seeding with conventional practice, higher and non-uniform plant population adversely affects the grain yield of different crops (Manish and Verma, 2017). Technological progress in the field of agriculture takes various forms, including agricultural machinery and equipment with technical characteristics (Shukr and Faris, 2011) .El-Hanafy (1997) indicated that the art of placing seeds in the soil to obtain high germination ratio and healthy plants is the goal of all agriculture producers. The applied researches emphasize that the cereal crops productivity are highly increased when the planting processes depend on seeders machine. In this study it was concluded that, using the developed opener in the case of dropping seeds behind the press wheel encourage the seeds to be more distributed through the improved furrow shape, and hence an accurate seed depth, more chance to seeds to contact with soil particles, proper cover on seeds and as a result the highest yield was obtained. Bagherpour (2019) indicated that the proper spacing of plants is important for maximum yield as well as for ease of care and picking. In agriculture, seeds that are sown by precision planters, offer greater precision than other traditional sowing methods, namely broadcasting and drilling. Silim et al., (1990) studied the effect of seeding density and row entail spacing on the lentil yield. They found that the using of seed drill represent a potential saving in seed costs of 20% to 30% compared with hand broadcasting. Soomro et al. (2009) investigated the sowing methods and seed rate on growth and yield of wheat. The results showed that sowing by drilling method significantly increased the plant vigor and yield. Moody et al., (2003) investigated the performance of a plate-type vacuum seeder for sowing maize and cotton seeds to study the effect of forward speed and meter speed on seed spacing within plant. It was

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concluded that the variance in seed spacing increased with the increasing ground speed. The basic objective of sowing operation is to bear the seed, put the seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed (Soyoye, 2020; Odumalet al., 2014; Soyoye et al., 2016). Soyoye (2020) found that when operated manually, the optimum planter metering device speed was 24 rpm (0.69 m/s), while the calculated field capacity of the planter is 0.187 ha/h, average performance efficiency of 95.5% with the average discharge and application rates of 7.86 kg/h and 42.1 kg/ ha respectively. When the planter was electrically operate at a metering speed of 40 rpm (1.15 m/s)d, it has the highest efficiency of 98% with the average discharge and application rates of 14.28 kg/h and 54.96 kg/ha respectively. Soyoye (2020) found that the total seed discharged (dropped) at the seed tube increased with decrease in the speed of the planter (metering plate speed). This is due to the fact that at high speed the seeds do not have enough time to drop into the cell groove there by resulting in the rebound of the seeds. Khairy (1997) studied performance evaluation of potato planter in sandy soil. The results indicated that the percentage of missing potato tuber increases with the increase of planting speed. And for all treatments, the percentages of double potato tubers increase with the increase of planting speed up to 6 km/h then decrease with the increase of planting seeds. Nave and Paulsen (1979) studied the effect of the difference in the type of feeding mechanism and the size of the seeds on the amount of mechanical damage on the seed viability, where they found that the size of large seeds is more vulnerable to mechanical damage compared to small seeds, and the use of different seed quantities leads to a loss in the seed quantities to be adopted per unit area. In addition to the above, the study demonstrated that the more seeds in the boxes, the less the seeds fall to the ground, and consequently the plant density. Al-Rajaboo (2011) indicated that Abdel-Rahman (1992) studied the effect of seed speed on some seed requirements. The results showed that the use of different seed speed has significant effects on the rate of seed slipping from the machine. And the study recommended that the appropriate speed should be less than 8 km / hour. Saqib (1993) found that the change coefficient of the seed distribution uniformity increased by increasing both the forward speed of the machine and the degree of inclination of the machine until a certain speed at 7 km / h, the seed distribution and uniformity begin to decrease. Rajaboo et al.(1995) studied the effect of forward speed and seeding depth by using the underlining machine on the product yield and some of the wheat components, where it was found that the speed had an effect on the product yield. The speed increases the amount of seeds bursting from the pruning unit, but it is a relative increase in relation to the increase in speed until the speed reaches 7 km / hour, when the yield decreases and the loss of the quantities of seeds increases. As it was mentioned by Al-Rajaboo (2011)the researchers Al-Suhaibani and Ba'abir, (1995) explained that the performance of two grain trains in alluvial sandy soils when the speed and seed quantities affect the homogeneity of the seed depth and the yield of the wheat crop, as it was found that the output of the wheat crop decreased

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with an increase in the speed of the underlining machine, due to the disruption of the action of the effluents in Determine the appropriate depth for germination of seeds. Hazza and Saif (1998) found that there is no effect of seed weight on the average distance between seeds in the line at the difference in seed masses in the box and remains within the permissible range, as they found that with an increase in the average speed from 3.6 km / hour to 5.5 km / hour the average distance between plants in the line increases from 19.4 cm to 20.4 cm, which is not very significant. Panning, et.al, (2000) Compared a number of laboratory and field tests on the extent of homogeneity and distribution of distances between seeds during the cultivation of the sugar beet crop and using different types of seeder machines at the speed of sowing (3.2, 5.6 and 8 km / h). They found that there are differences between the results of laboratory and field tests of the coefficient of different homogeneity of seed distribution within one line at the difference of both the machine type and the actual seed speed. Soza, et.al, (2004) showed that there was an increase in the mechanical damage ratio at the seeder machine (TS) and a decrease in the germination percentage compared to the seeder machine (TA) while there were no significant differences in the two seeders in the characteristic number of fallen seeds / m while there were significant differences between them when describing the number of growing plants / m. The reason for the variation in the results may be due to the type of seed in addition to the type of chicken, the feeding mechanism system, the seed covering system and both seeder machines. Afzalinia, et.al, (2006) studied the performance evaluating of four types of seeder machines used in wheat crop sowing. They showed that there were no significant differences between the types of underlining mechanisms in terms of the ratio of consistency of seed distribution within a single line while there were Significant differences in the coefficient of homogeneity of seed depth distribution in some machines used in the experiment. They attributed the reason for this variation to the type of feeding mechanism and to the type of furrow opener responsible for regulating the depth of the seed, which affected the number of seeds remaining scattered and floating on the surface of the soil and consequently affected this characteristic. Searle, et.al, (2008) studied the effect of different speed and quantities of seed to evaluate the maize planter. They found the difference in seed speed, field inclination, and type of feeding mechanisms had a significant effect on the homogeneity and distribution of distances between the maize seeds. Umed, et.al, (2009) Compared three types of sowing methods for wheat (sowing machine, sprinkle sowing and sowing in the presence of water) and at three different rates of seed quantities. They found that the sowing mechanism significantly outperformed the rest of the agricultural methods and at all growth characteristics. The results showed that the increase in the quantities of seeds significantly affected the improvement of the growth characteristics of the yield and at all cultivation methods. This study showed that the increase or decrease of the distance at the opening of the seed drain from the tanks and between the valve and the mouth of the feeding opening leads to an increase or decrease in the rate of discharge by a direct relationship. Al-

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Rajaboo and Al-Sandouk, (2012) studied the performance of Gaspardo mechanical seeder in sowing wheat crop under supplementary irrigation. The research included evaluating the performance indicators of mechanical seeder by adopting three factors they are the seed quantity at two levels (100,120) kg / ha, and depth of seed (6 and 4) cm, with two ground speeds (5.5, 4.5) km / h. The results of this study showed a significant superiority of the quantity of 100 kg / ha in the length and number of spike grains compared to the quantity (120) kg / ha. Muhammed, (2017) studied possibility of utilizing grain drill (GASPARDO SC-250) in planting two type of different crops (chickpea and green bean) under three levels of sowing speed (4-5 and 7-8 and 10-11) km/h , two levels of sowing rates (15 and 20) kg/don. He found that speed (4-5) km/h has the highest results for the characteristic of No. of seed /5m length comparison with two speed (7-8 and 10- 11) km/h respectively. Whereas the sowing rate (20) kg/don has the best results in all the characteristics comparing with sowing rate (15) kg/don. The aim of this research was to study the effect of forward speed, the weight of the grain in the boxes and the grain discharge opening on the rate of discharge, the plant density and the number of plants in the line.

2. MATERIAL AND METHODS

The experiment was carried out to evaluate the performance of the wheat seeder machine in the farm of the Faculty of Agriculture and Veterinary Medicine / Thamar University - Dhamar Governorate. It was conducted on 14/05/2017 by using the wheat seeder machine (Gaspardo NO-0709). Three factors were selected for this research they are discharge holes at two levels (20 and 40 kg / ha x 6 boxes), forward speed, with three levels (2.05-2.02), (3.80-3.70) and (4.05-3.91) km / h and the quantities of seeds at three levels (2, 3 and 4) kg. The number of transactions became 18 transactions. An improved variety of Saba of wheat from the Propagation Corporation was used. The laboratory germination percentage for this variety was 84%, and the purity was 84%.

2.1 Seeder Machine Specifications

Table 1 shows the machine specifications

Table 1: Machine specification

Machine width (m)	No. of Seed boxes	No. of Fertilizers boxes	Distance between lines (cm)	No. of Seeds Feeding tubes	No. of fertilizer Feeding tubes
2.5	6	6	22	12	12

2.2 Steps of the experiment

This experiment was carried out at the farm of the Faculty of Agriculture, Thamar University in two stages:

1. Without sowing:

This experiment was carried out to determine the effect of grain weight on the percentage of discharge. The length of the experimental unit (90 meters).The experimental unit is divided into three fractional experimental units of 30 m length. Plastic bags were placed at the end of each tube to collect the seed samples and the bags were numbered for each feeding tube in order to assess the rate of discharge of each feeding tube separately. The amount of seeds descending from the feeding tubes to the plastic bags was collected and weighed by an electronic balance.

2. With sowing:

The same quantities of seeds, forward speeds, drainage holes and the same distance were used, to know the extent of their effect on the field density and the average number of plants present in 1m of length. The experimental data were analyzed using analysis of variance (ANOVA). The means were compared with LSD at 5% level significance for all study parameters. This analysis was performed by Statistical Analysis SAS program.

The speed of seed discharge was calculated using the following formula (Juburi et al., 2012):

$$V = S/T * 3.6 \text{ (km/h)} \quad (1)$$

Where, V is forward speed (km / h); S is length of treatment (m) and T is time (s)

2.3 Measuring studied field characteristics

1. The plant density was calculated by taking several random samples, from the field for each experimental unit and with four replicates, by calculating the average number of plants per square meter (average number of plants / m^2). This was done by taking the general average of the four replicates, and converting them into percent.
2. The average number of plants in 1 m length (average number of plants / 1 m length) was calculated by taking several random samples with four repeats and then taking the general average.

3. RESULTS AND DISCUSSION

3.1 Effect of seed discharge openings, forward speed and grain weight on the rate of discharge, the plant density and the number of plants in the line

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3.1.1 Effect of seed discharge openings on discharge rate

Table 1 shows the effect of the discharge openings on the discharge rate. From the table, there are significant differences between the two drainage holes, where the discharge opening (40 kg / ha x 6 boxes) outperformed the discharge rate, which gave a discharge rate of 168.3 g, with a significant difference (5.59) compared to the hole (20 kg / ha x 6 boxes) that gave a discharge rate 30.00 g. The reason for this is due to the increase in the diameter of the seed discharge hole, which results in an increase in the quantities of seeds that fall through this hole to the feeding mechanism in a way that is compatible with the approved seed quantity. Consequently, the discharge rate increases with the diameter of the discharge opening increasing, and this is consistent with (Umed, et.al, 2009) and (Al-Rajaboo and Al-Sandouk, 2012).

Table 1: Effect of the discharge openings on the discharge rate

Discharge openings (kg/ha) 6xboxes	The average of discharge rate (g)
20	30.00[b]
40	168.03[a]
L.S.D	5.59

*Averages with different letters indicate significant differences

3.1.2 Effect of forward speed on the seed discharge rate

Table 2 shows the effect of forward speed on seed discharge rate. It turns out from the table that there are very simple significant differences that do not reach the degree of significance in the rate of discharge at the difference in speed. However, the speed (4.05-2.02) km / h exceeded a slight superiority that might reach the degree of significance, as it gave a discharge rate of (108.542) compared to the speed (3.80-3.70) km / h which gave a discharge rate of (98.333) g, while it exceled significantly. Compared to the speed (2.05-2.02) km / h, which gave a discharge rate of (90.625) g. This simple superiority in the rate of seed discharge is due to the effect of the three speeds on the seed feeding unit, which is responsible for regulating the amount of fallen seeds, through which it was a similar effect. That is the effect of the increase in speed from (2.0484-2.02) to (3.80-3.70) and to (4.05-3.91) km / h on the rate of discharge was not a sufficient effect in reaching the degree of significance, as we note from the data of Table 2. The average drainage of the machine increased with increasing the speed with a slight increase that did not reach the degree of significance. This increase is due to the amount of the feed unit benefiting from the increase in speed and its derivation by greater impetus, which helps it to push the amount of seeds easily only with a slight increase of the amount of seeds that fall as a result of the vibration of the machine. This explains the reason for the simple effect of the third speed, which is due to the slippage of small quantities of seeds as a result of the increase in speed, not

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that due to the benefit of the feed unit from the increase in the number of propulsions of the feed unit due to the increase in the number of wheels of the underlining machine in relation to the unit of time when increasing the speed because the number of driving cycles The feeding unit needed to grow a specific area was equal, no matter how quickly the seeding speed increased, but the time needed for the feed unit to push the seeds to grow this area increased. This is consistent with (Al Rajboo et al., 1995), (Abdul Rahman, 1992) and (Muhammad, 2017).

Table 2: Effect of forward speed on the seed discharge rate

Forward speed (km/h)	The average of discharge rate(g)
2.02 – 2.05	90.625[b]
3.70 – 3.80	98.333[ab]
3.91 – 4.05	108.542[a]
L.S.D.	6.843

*Averages with different letters indicate significant differences

3.1.3 Effect of Seed quantities on the discharge rate

Table 3 shows the effect of seed quantities on the discharge rate. The discharge rate was decreased from 111.250g to 98.958g and to 87.292g by increasing the seed quantities from 2 kg to 3 kg and to 4 kg respectively. The quantity of seeds (2 kg) achieved the highest discharge rate of 111.25 g, with a significant difference of 6.843. The reason for the decrease in the rate of discharge is due to the fact that the movement of seeds goes down with the increase in the amount of seeds and that the higher the pressure of the seeds at the seed mold and the feeding hole reduces the ease of the rushing of the seeds to the seed feeding tubes, where the competition of seeds emerging from the drain hole increases with increase the quantity, which impedes the movement of seeds and reduces the permissibility of descending more number of seeds through the feeding mechanism, and this is consistent with (Nave and Paulsen, 1979).

Table 3: Effect of seed quantities on the discharge rate

Quantity of seeds (kg)	The average discharge rate (g)
2	111.250[a]
3	98.958[b]
4	87.292[c]
L. S. D.	6.843

*Averages with different letters indicate significant differences

3.2 Effect of discharge openings, forward speed and grain quantities on the number of plant in 1 m length

3.2.1 Effect of discharge openings on the number of plants in 1 meter length

Table 4 shows the effect of discharge openings on the average of plant in 1 m length. The results show that there is high significant effect of discharge openings. The average of plants number in 1 m length increased from 39.694 to 54.778 by increasing the opening from (20 kg/ha *6 Boxes) to (40 kg/ha*6 Boxes) respectively. The increase in seed discharge openings led to increase in plant number in 1 m length. The results in the table show that the seed discharge openings has a highly significant effect. The higher the seed discharge openings, the greater the numerical value of plants present in 1 meter of length. A discharge opening (40 kg / ha x 6 boxes) achieved the highest numerical value of plants / 1 m length with an average of (54.778) plants and a significant difference (2.1603), compared to discharge opening (20 kg / ha x 6 boxes) which achieved average of (39.694) plants. The reason for this is the increase in the diameter of the seed discharge hole, which leads to an increase in the quantities of seeds that are bursting and falling from the drain hole to the feed unit that taps them into the seed feeding tubes and then puts them in the depth determined for them. Thus the numerical value of the plants growing increases by 1 meter in length, and therefore the distance between the plants decreases and this is consistent with (Mohammed, 2017).

Table 4: Effect of discharge openings on the number of plants in 1 m length

Discharge openings (kg/ha) * 6 Boxes	The average of plants number (plant/1 m)
20	39.694^{b}
40	54.778^{a}
L.S.D.	2.1603

*Averages with different letters indicate significant differences

3.2.2 Effect of forward speed on the number of plants in 1 meter length

Table 5 shows the effect of the difference in speed on the average number of plants present in 1 meter of length. The table shows that the effect of speed on the numerical value of plants present in 1 meter of length was a minor effect that did not reach the degree of significance. However, the speed (4.05-3.91) km / h exceeded a slight superiority that might not reach the degree of significance. Where it gave a numerical value (49.250) plants / 1 meter in length compared to the two speeds (2.05-2.02) and (3.80-3.70) km / hour, as the numerical value of them (44.583, 47.875) plants / 1 meter in length, respectively. And that this reason is also due to the type of feeding mechanism and the work of chicken and the extent of their influence by the speed factor

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that contributes to determining the increase or decrease of the quantities of seeds that fall in the appropriate depth for them to grow. The more appropriate the speed for the underlining machine to place the seeds at the prescribed depth, the higher the numerical value of the plants present in 1 meter of length. However, the increase in the numerical value of plants by 1 meter in length with increasing speed does not continue and begins to decrease as the speed increases above the permissible range that does not affect the work of chickens in standardizing the depth of the seeds. Because the increase in speed leads to disturbance of the underlining machine, and thus the disruption of the work of chicken, up and down, and the amount of seeds lost increases. When the chicken rises and the speed increases, the seed feeding tubes place the seeds deep near the surface of the soil and may be exposed, exposing them to birds and insects. When the chicken falls below the prescribed depth as a result of the disturbance of the machine with increasing speed, it leads to placing a quantity of seeds at depths far from the soil surface, which makes the opportunity for growth and its exit from the soil surface extremely difficult, especially when insufficient moisture stored for the seeds in the continuity of growth. Thus, the numerical value of plants present in 1 meter of length increases in simple increments and the distance between plants decreases when the speed increases in the permissible range, then the numerical value of plants increases and the distance between plants increases the speed increase over the permissible range. This is consistent with (Searle.et.al, 2008) and (Mohamed, 2017).

Table 5: Effect of forward speed on the number of plants in 1 meter length

Speed (km/h)	The average of plant number (plant/1 m)
2.02 – 2.05	44.583[b]
3.70 – 3.80	47.875[ab]
3.90 – 4.05	49.250[a]
L.S.D.	2.6459

*Averages with different letters indicate significant differences

3.2.3 Effect of seed quantities on the number of plants in 1 meter length

Table 6 shows the effect of different seed quantities on the number of plants present in 1 meter of length. The results in the table show that the quantity exceeded 2 kg with a significant difference in achieving the highest number of plants present in 1 meter length (52.458) plants / 1 meter length compared to the two quantities (3 kg, 4 kg). This is also due to the effect of the feeding mechanism or feeding unit with the quantities of seeds present and crowded in front of the seed opening where the seed pressure is generated there and that this pressure increases with the increase in the quantities of seeds in the tanks. Consequently, this pressure affects the movement of the seeds to the front of the feed unit, so it is difficult to rush all the crowded quantity of seeds in front of the drain hole. For this, increasing the size of the seeds inside the tanks of the

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underlining reduces the ease of the rush and slipping of the seeds, and consequently, affects the number of plant lines. In addition to the mechanical damage to the seeds, the collision between them resulted in the occurrence of a fracture of the seeds due to friction and collision between the seeds inside the feeding mechanism portfolio, which leads to a percentage of mechanical damage to the vitality of the seeds, thus reducing the number of plants present in the cultivation lines. This is consistent with (Muhammad, 2017).

Table 6: Effect of seed quantities on number of plants in 1 meter length

Quantities of seeds (kg)	The average of plant number (plant/ 1 m)
2	52.458[a]
3	47.833[b]
4	41.41[c]
L.S.D.	2.6459

*Averages with different letters indicate significant differences

3.3 Effect of the seed drainage opening, the forward speed and the quantities of seeds on the plant density in the field

3.3.1 Effect of drainage openings on the plant density in the field

Table 7 shows the effect of the drainage openings on the plant density in the field. The results in the showed that the superiority of the discharge opening (40 kg / ha x 6 boxes) significantly higher in the field density value with an average of 219,111 plants / m2 compared to the discharge opening (20 kg / hectares x 6 boxes) which was an average of 158.778 plants / m2 where it was distinguished by a significant difference 8.641 By increasing the diameter of the drainage hole, the quantity of seeds falling from the drainage opening passing by the feed unit increases, so the number of plants growing in the field increases. This is consistent with both (2009, Umed) and (Muhammad, 2017).

Table 7: Effect of the drainage openings on the plant density in the field

Drainage openings (kg/ha)	Plant density (plant / $1m^2$)
20	158.778[b]
40	219.111[a]
L.S.D.	8.641

*Averages with different letters indicate significant differences

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3.3.2 Effect of forward speed on plant density in the field

Table 8 shows the effect of forward speed on plant density in the field. The results in the table showed that there were no significant differences for the three speeds, and the reason may be that these three speeds are still of the recommended speed. As the speed increases, the homogeneity and uniformity of the seed depth distribution increases, so the number of plants per unit area increases with an increase that may reach the degree of significance. For this reason, there were minor differences, which did not reach the level of significance when describing plant density according to the speed. According to many studies when using an automatic speed greater than (8-7 km / hour), there are significant differences in this characteristic according to the difference in seed speed, as the plant density decreases with increasing speed of ((8-7 km / hour) due to the heterogeneity in the depths of the seeds Which increases the amount of seeds lost as a result of the disruption of the work of chickens to unify the appropriate depth of the seeds at this speed and this is consistent with (Abdul Rahman, 1992) and (Al-Suhaibani and Baabir, 1995) and (Muhammad, 2017).

Table 8: Effect of forward speed on plant density in the field

Forward speed (km/h)	Plant density (plant/1m^2)
2.02 – 2.05	178.333^{b}
3.70 – 3.80	191.500^{ab}
3.91 – 4.05	197.000^{a}
L.S.D.	10.583

*Averages with different letters indicate significant differences

3.3.3 Effect of seed quantities on plant density in the field

Table 9 shows the effect of seed quantities on plant density in the field. The results indicate that the seed quantity significantly exceeded 2 kg in giving the highest plant density with an average of 209,833 plants / m2 compared to the quantities of seeds (3 and 4 kg). The reason is that using the same drain hole with different seed sizes inside the tanks and increasing the amount of seeds leads to difficulty sliding from the drain hole easily due to the generation of seed friction with each other in front of the drain hole and between the parts of the feeding machine, which reduces the slip of the seed quantity easily, thus reducing plant density In the field, this is confirmed by (Muhammad, 2017).

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Table 9: Effect of seed quantities on plant density in the field

Seed quantities (kg)	Plant density (plant/1m^2)
2	209.833[a]
3	191.333[b]
4	165.667[c]
L.S.D.	10.583

*Averages with different letters indicate significant differences

4. CONCLUSIONS

As the discharge opening increases, both the amount of spent seeds and the number of plants in the line increase, while the distance between plants and the number of plants per unit area decreases, so the plant density increases. With the increase in the amount of seeds in the boxes, the quantity of the seeds coming out and the number of plants per line decreases, while the distance between plants increases and the number of plants per unit area decreases, thus the plant density decreases. By increasing the forward speed of the machine, the rate of seed discharge increases, and it may reach the degree of significance. The plant density and the number of plants in the line increases until they reach the highest value when the speed reaches the optimum level, then the plant density and the number of plants decrease when the speed exceeds the optimum level.

Therefore, the following are the key recommendations which might be taken:

1. The drainage opening (30-40 kg / ha x 6 boxes) can be used to obtain suitable plant density.
2. The machine can be used with uniform seed quantities in all boxes to limit the variation in the rate of discharge of each feeding tube and thus limit the variation in the number of plants in the line and the variation of plant density in the field.
3. A seed quantity of about (30-40 kg) can be used in each box when planting one hectare, equivalent to (180-240 kg / ha), to obtain non-competing plants and suitable plant density with high yield.
4. Sowing speed (4-5 km / h) can be used in order to obtain a homogeneous crop in the field density and in the numerical value of the plants in the line.

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