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The Effect of Disc Seeder Performance and The Type of Seed Coating on The Germination Percentage of Wheat Grain

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Abstract: An experiment was carried out to detect the effect of disc seeder and the type of seed coating on the rate of wheat grain germination in a farmer's field in Kirkuk Governorate. A Russian made seeder S.Z-3.6 with double disc plough was used in order to compare the efficiency of various types of coating. These types of coating are: the traditional coating, the traditional coating with attaching a leveling harrow, the coating by using the two scrapers, and coating by increasing the field speed of the seeder by four speed levels (6, 8, 10 and 12) km/h. The indicators of regularity of vertical grain distribution, which was %, seedling emergence from the soil was %, lateral soil throw, regularity of horizontal grain distribution was %, and the average depth of grain coating (mm), were studied. The key results were summarized as follows: The increase in field speed caused an imbalance in the distribution of wheat grains inside the soil, which led to a significant decrease in the germination and emergence indicators when using the traditional coating mechanism. The treatment by attaching a leveling harrow to the traditional coating mechanism was significantly superior in most indicators of grain distribution within the soil, germination and emergence indicators compared to the traditional coating and for all levels of field speed. Moreover, the use of the two-scraper coating mechanism led to the improvement of all indicators of grain distribution within the soil with all the studied speed. This contributed to obtaining significant increases in the rate of seedlings emergence. The effect of bilateral interactions between the two factors was consistent with the individual effect of each of the studied factors.

Keywords: Cereal seed, covering mechanism, wheat.

I. INTRODUCTION

One of the key goals to be achieved when using any seeder or planting equipment is to place the grains at an appropriate depth for their growth. Therefore, the absence of seeding process is one of the sources that are vital in calculating the economic costs of crop production. The absence of one grain means losing a group of spikes, so how about if there are dozens of lost grains as a result of their random fall at different seed depths within one square meter. As a result, a decrease in the percentage of field germination appears [1]. This importance of the seed planting site comes from its direct effect on germination, seedling emergence, rootstock spread, ability to survive, fighting with the bush to survive, regularity of maturity date, and yield quantity [2].

Placing the grains at the appropriate depth is half of the equation, while the other half is to coat these grains with soil as a limiting factor for the regularity of the grain depth. The more regular the coating, the more regular the final depth of the grain, and it becomes possible to obtain good and even germination. Therefore, grain coating (the height of the soil coating the grain) is affected by the location of the grain within the furrow and the amount of soil coating the grain [3]. In order to increase the accuracy of the depth of the grain, it is necessary to use coating systems that do not depend on the reverse collapse of the sides of the furrow, but rather contain special mechanisms placed next to theplough that cover the grain [4].

[5] stated that good grain coating is a determining factor for good seedling emergence and better root system growth. Thus, it is more abundant when compared to final coating methods that do not cover the grains, such as the manual planting method.

[6] found that the use of appropriate coating gave the best results in terms of the percentage of emergence, the total number of standing plants, and the yield. This is justified by the quality of the location of the grain within the soil and the sufficient connection between the grain and the surrounding soil. Field speed is one of the most influential factors in grain depth regularity. When the speed increases, it becomes difficult to control the grain depth even with the pressure of wheels. The reason is that the very high speed causes the disc plough to remain outside the soil for most of the time, especially when the plough passes over the solid dirt masses or deep penetration into the soft soil. This causes a very high variability in the regularity of grain depth within the soil [7].

The grain depth depends largely on the type of coating adopted, and the height of the soil above the grain required to obtain good, regular and fast germination is (25-40) mm in soft-weave soils and (50) mm in coarse-

weave soils. The depth of the soil above the grain should not exceed (75) mm for wheat and barley crops [8], [9] showed that the grain depth and its regularity depend greatly on the ability of the coating system adopted with the cultivator to return the soil to the furrow regularly before the grain stabilizes, as well as its ability to stop and prevent the phenomenon of lateral soil throw into the adjacent furrows. Noted that increasing the field speed from (3.6-7.2) km/h led to a decrease in the grain depth and an increase in the depth irregularity for the double-plough disc seeders. These results were of a significant preference compared to the results achieved by the digger-axe seeders for the above two characteristics and under the same conditions of the experiment. The aim of this study is to improve the performance of the disc seeder through using various coating mechanisms and to evaluate the effect of adding these mechanisms on the percentage of germination ofwheat grains in a wide range of working speeds to reach the optimum utilization of the seeding equipment [10].

II. MATERIALS AND METHODS

An experiment was conducted to detect the effect of disc grain seeder and the type of coating mechanism on the rate of wheat grain germination in a farmer's field in Kirkuk governorate in order to compare the efficiency of various coating mechanisms. These mechanisms are the traditional coating, the traditional coating by attaching a leveling harrow and coating using the two scrapers. The second factor is the field speed of the seeder for levels (6, 8, 10 and 12) km/h. That is, the research included two different factors, as the split part design was used according to the randomized complete block design with four replications. The Least Significant Difference L.S.D test was used to compare the means at the 5% probability level [11].

The regularity of the feeding mechanisms was tested by calculating the coefficient of variation (C.V) for the number of grains coming out of all the feeding mechanisms of the seed according to the method adopted by the Prairie Agricultural Machinery Institute (PAMI) stations. If the coefficient of variation is (15% > CV > 0%), then the feeding mechanisms will give equal quantities of grain satisfactorily, while if the coefficient of variation is (CV > 15%), the regularity of the feeding mechanisms work will be weak and unacceptable [10]. The research was carried out by using the Massey Ferguson (MF 285 S) tractor, and a Russian-made (S.Z 3.6) fertilizer seeder with a double disc plough. A seeding rate of 100 kg/ha of barley grain was adopted for all treatments. The following characteristics were measured and evaluated in the research:

- The regularity of grain distribution vertically %: This characteristic was represented by the irregularity of the grain depth, which is represented by the standard deviation of the successive seed depths in one line for twenty grains.
- Emergence of seedlings from the soil %. It is the rate between the number of seedlings emerging m^2/average number of sown seeds m^2.
- Lateral soil throw: The rate between the grain depth in the furrows of the front row to the grain depth in the furrows of the back row of the seed.
- The regularity of grain distribution horizontally %: This characteristic was represented by the indicator of irregularity, the distance between adjacent grains, represented by the standard deviation of the distance between successive seeds in one line for twenty grains.
- Mean depth of seed coating (mm): It represents the average height of the soil coating the grain and the whole seedbed.

III. RESULTS AND DISCUSSIONREGULARITY OF VERTICAL GRAIN DISTRIBUTION

The results of Table (1) showed that the increase in field speed led to significant increases in the regularity of vertical grain distribution, reaching from 56.642% to 69.342%, respectively. The reason is because the increase in the field speed increases the disturbance of the movement of the plough, in addition to bouncing the grains and rolling them inside the furrow when the speed increases, the depth of the plough movement decreases, and the phenomenon of lateral soil throw increases. This results in irregularity in the amount of soil coating the grains in one furrow. This is consistent with what was found by [12], [13].

The coating factor had a significant effect on the regularity of vertical grain distribution. It seems clear that the use of the traditional coating mechanism was accompanied by a high value of the depth irregularity, which was 86.176%. This is because the experiment was carried out by using a relatively high ground speed, which caused an increase in the disturbance of the movement depth of the ploughs and a decrease in the depth. Also, the increase in speed causes an increase in the continuity of movement of the grain after descending from the seed and bouncing it inside the furrow, in addition to the relative delay in the final coating of the grain. The grains will not settle at the bottom of the furrow,but rather spread vertically inside and may come out. On the other hand, there is a difference in the amount of soil returned to the furrow in the partial and final coating due to the phenomenon of lateral throw of the stirred soil. This increases the variability of soil height above the grain increasing the depth irregularity. This is consistent with what was found by [14], [15].

Furthermore, attaching a leveling harrow between the two discs of the disc plough led to a decrease in the depth irregularity, reaching 79.207%. The reason is that attaching the harrow helped prevent the grain from rolling and bouncing after it descended into the furrow, which accelerated its stability and increased its regularity at the bottom of the furrow. Despite, the values remain relatively high due to the phenomenon of lateral soil throw and the irregular return of the soil to the open furrows, as it comes from the partial and final coating of the back furrows. As for the front furrows, they come from the partial and final coating, in addition to the soil coming from the side throw. Thus, there is a large variation in the height of the soil coating the grain. Moreover, the use of the two-scrapers coating mechanism significantly reduced the values of the depth irregularity. The values were 21.006%, because these two scrapers directly returned the stirred soil to the same furrow, which led to the speed of the coating process. Therefore, preventing the grain from being rolled and trampled inside the furrow, as well as the regularity of returning the soil to the open furrow, as it comes from only one source, which is these two scrapers. This greatly increases the evenness of the soil above the grains which yields lower depth irregularity values. This is consistent with what was mentioned by [16].

The effect of the interaction of the speed and coating factors was significant in terms of depth irregularity. It is noted that the use of a leveling harrow between the two plough discs had relatively improved the regularity of the depth of the planted grains despite the increase in the speed compared to the traditional coating. The treatments in which the two scrapers were used,showed that it was possible to increase the field speed within the study ranges while maintaining low values of the depth irregularity due to adjusting both the location of the grain inside the furrow and the regularity of the amount of soil covered when using these two scrapers [17].

TABLES 1. THE EFFECT OF FIELD SPEED AND TYPE OF COATING MECHANISM ON GRAIN DEPTH IRREGULARITY

Speed coating	Average of coating	V1	V2	V3	V4
Traditional	86.176	81.893	83.464	87.008	92.34
Traditional + leveling harrow	79.207	73.928	76.151	80.744	86.007
Coating by two-scraper	21.006	14.107	17.59	22.65	29.679
Speed rate		56.642	59.068	63.467	69.342
LSD coating =0.626 LSD speed= LSD 0.635 overlap=4.184					

IV. THE PERCENTAGE OF SEEDLING EMERGENCE

Observing Table (2), we find that the increase in the field speed within the study ranges caused a significant decrease in the rate of seedling emergence from 77.579 to 61.740, respectively. The reason is that the increase in the field speed increases the disturbance of the movement of the plough, which leads to the fall of the grains at very various depths that may be superficial. This is what makes it susceptible to capture by birds, rodents, and ants, or it may not have enough moisture for germination, or it may be buried far from the surface so that it is difficult for it to emerge to the surface of the soil even if it germinates inside it because of the long distance that the blade must travel in order to be able to emerge on the surface of the soil. This result is consistent with what was found by [18].

Coating had a significant effect on this characteristic, as the use of the traditional coating did not provide sufficient coating within the study conditions. Therefore, the emergence rate decreased to 63.919%, while attaching a harrow for leveling the soil to the plough contributed to raising the emergence rate to 78.307%, as a result of increasing the regularity of the position of the grains inside the soil when using the leveling harrow, which increased the emergence rate.

The use of the two scrapers in the coating process led to a significant increase in the emergence rate under the experimental conditions compared to the other two methods. The rate of emergence was 77.91%, because the use of this mechanism increased the regularity of the grain depth inside the soil, at depths that were ideal for germination and emergence, in which the loss of grain was reduced, and thus the percentage of seed emergence increased. This is consistent with what was mentioned by Slattery et.al [19], [20].

The interaction of the two field speed factors and the type of coating had a significant effect, where the traditional coating mechanism was unable to keep up with the increase in speed and could not cover the grains as required. Thus, the percentage of seedling emergence decreased, while attaching a leveling harrow helped to increase the regularity of grain depth and increased the percentage of emergence compared to the traditional coating mechanism. However, the higher grain coating heterogeneity causes a significant reduction in the emergence rates at high speeds. The treatments in which the two scrapers were used in the coating process showed the possibility of increasing the field speed within the limits of the study while maintaining somewhat acceptable emergence rates. The rate of emergence at a speed of 11 km / h for the traditional coating parameters

with leveling harrows and coating with the two scrapers was the following ratios 53.836, 59.383 and 72.003%, respectively.

TABLES 2. THE EFFECT OF FIELD SPEED AND TYPE OF COATING MECHANISM ON THE PERCENTAGE OF SEEDLING EMERGENCE %

Speed coating	Average of coating	V1	V2	V3	V4
Traditional	63.919	71.875	83.464	61.383	53.836
Traditional+ leveling harrow	68.733	76.678	72.763	66.109	59.383
Coating by two-scraper	78.307	84.185	80.931	76.109	72.003
Speed rate		77.579	74.092	67.867	61.740
LSD coating 0.503=LSD speed= LSD 0.586 overlap=1.631					

V. LATERAL SOIL THROW

The results in Table (3) show that the increase in the field speed caused a significant increase in the phenomenon of lateral soil throw, as its rate was from 2.48 to 3.128, respectively. The reason is that the increase in the linear speed of the corrugation increases the acceleration with which the stirred soil is thrown from the rear furrow to reach the previously opened front furrows, and thus the final coating increases compared to the rear furrows. This result is consistent with what was mentioned by [21], [22].

The use of the two-scrapers coating was significantly superior to the traditional coating methods by attaching a leveling harrow in its ability to reduce the phenomenon of lateral soil throw and to achieve an almost equal coating depth of the grains in the front and back rows of the seed, which amounted to 2.076. There was no significant difference between the other two means, as it reached 3.147 and 3.147, respectively. The reason for the high rates of this attribute is due to throwing the soil stirred from the furrows of the back row of the seed into the furrows of the front row when using the traditional coating means with spring thorns or the regular coating mechanism with a leveling harrow. The use of the two scrapers in the coating process resulted in returning the soil stirred from the furrow to the same furrow. Therefore, it does not get thrown into adjacent furrows. Therefore, the height of the soil coating the grain for all furrows will be approximately equal, and the proportions of this attribute will be close to one [23].

The overlap of the field speed and the type of coating mechanism had a significant effect on this characteristic, and the lowest percentages coincided with the use of the coating mechanism with two scrapers for all speeds, reaching 2.071, 2.073, 2.075, and 2.088, respectively. This indicates that the use of the two scrapers reduces the phenomenon of lateral soil throw and allows an increase in field speed, while the increase in speed by using the other two methods was accompanied by clear increases in the rates of this attribute, which was 3.658.

TABLES 3. THE EFFECT OF FIELD SPEED AND TYPE OF COATING MECHANISM ON LATERAL SOIL THROW

Speed coating	Average of coating	V1	V2	V3	V4
Traditional	3.147	2.682	2.953	3.297	3.658
Traditional+ leveling harrow	3.147	2.687	2.968	3.293	3.64
Coating by two-scraper	2.076	2.071	2.073	2.075	2.088
Speed rate		2.48	2.664	2.888	3.128
LSD 0.037= coating =LSD speed= LSD 0.062 overlap=0.861					

VI. REGULAR GRAIN DISTRIBUTION HORIZONTALLY

The results of Table (4) showed that increasing the field speed caused a significant increase in the indicators of regularity of grain distribution horizontally from 39.982% to 63.606%, respectively, because increasing the field speed leads to an increase in the speed of seed release from the seed. Thus, the displacement that the grain travels before and after its initial collision with the soil increases as the field speed increases. This is consistent with the findings of [24].

There is a high variation in the regularity of the horizontal grain distribution among the grains when using the traditional coating mechanism as a result of delaying the coating process as it comes after the completion of the opening of the furrows. Thus, there is an ample time for the grain to continue moving and rolling after it descending into the furrow. A large variation occurs in the distance between the grains, and more so when there is a weakness in the self-partial coating of the furrow, as the irregular distance for this mechanism reached 81.527%. It is clear from the same table above that attaching a leveling harrow between the two plough

discs helped greatly in increasing the regularity of the distance among the grains and significantly reduced its variability compared to the traditional coating. The reason is that this harrow presses the grain to the bottom of the furrow immediately after it descends from the grain tube and prevents it from continuing to move or roll. Therefore, the distances among the grains will be determined mostly by the regular flow of the grains and their descent from the grain tube (i.e. the regularity of the feeding mechanisms).

We also find that coating by using the two scrapers gave similar results to the use of a leveling harrow. These two methods did not differ significantly between them, noting the slight increase in the depth irregularity values for coating with the two scrapers. The reason for this is that the use of the two scrapers speeds up the process of coating the grain after it descends from the grain tube to the bottom of the furrow and increases the uniformity of the distance between them. This is in agreement with [25], [26].

The overlapping of the field speed and the type of coating had a significant effect on this characteristic, as the increase in the field speed when using the traditional coating mechanism led to raising the distance irregularity to a high rate of 114.579%. This indicates the inability of this mechanism to achieve the requirements of distance regularity at high speeds, while attaching a leveling harrow to the gap contributed to reducing the large increases in the distance irregularity indicators and accompanying the increase in speed and reducing these increases so that they became few. The coating mechanism which uses two scrapers showed a similar and close effect to the effect of the leveling harrow, and it did not differ from it significantly for all levels of speed.

TABLES 4. THE EFFECT OF FIELD SPEED AND TYPE OF COATING MECHANISM ON THE IRREGULAR DISTANCE BETWEEN GRAINS

Speed coating	Average of coating	V1	V2	V3	V4
Traditional	81.527	52.981	67.641	90.908	114.579
Traditional + leveling harrow	34.832	32.915	33.715	35.599	37.1
Coating by two-scraper	36.611	34.05	35.971	37.284	39.14
Speed rate		39.982	45.775	54.597	63.606
LSD 1.15 = coating =LSD speed= LSD 1.518 overlap=11.205					

VII. AVERAGE GRAIN COATING DEPTH (MM)

The results of Table (5) showed that increasing the field speed within the experimental ranges led to a significant decrease in the grain depth from 60,520 to 44,864 mm, respectively. Increasing the speed causes a decrease in the depth of the plough work inside the soil, and thus the average grain depth decreases in general. This is consistent with what was found by [27].

The type of coating mechanism was significantly affected in this characteristic, as the treatments of the traditional coating and coating with a leveling harrow were significantly superior to the coating mechanism with two scrapers. These two treatments gave average coating depths of 57.319 and 57.433, respectively, and coating with the two scrapers gave the lowest average of 43.251. This superiority comes from increasing the height of the soil coating the grains in the front row as a result of excessive coating. The interference of the field speed with the coating mechanism had a significant effect on this characteristic, and that the largest grain depth coincided with the lowest speed level. This was done using the traditional coating with attaching a leveling harrow of 64.406 mm, while the lowest values for the average grain depth appeared with the highest speed and using the coating mechanism with two scrapers, as it was 35.771 mm.

TABLES 5. THE EFFECT OF FIELD SPEED AND TYPE OF COATING MECHANISM ON AVERAGE GRAIN DEPTH (MM)

Speed coating	Average of coating	V1	V2	V3	V4
Traditional	57.319	63.956	60.315	55.923	49.084
Traditional + leveling harrow	57.433	64.406	60.196	55.393	49.739
Coating by two-scraper	43.251	53.199	45.303	38.733	35.771
Speed rate		60.520	55.271	50.016	44.864
LSD 0.537 = coating =LSD speed= LSD 0.637 overlap= 5.161					

VIII. CONCLUSION

It is concluded from the aforementioned that the use of efficient coating mechanisms makes it possible to increase the speed of the seeding process while maintaining the specific specifications required for this important agricultural process.

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