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Effect of Sowing Patterns on the Components and its Yield of Two Barley Varieties in the Sulaymaniyah

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ABSTRACT

The current study was conducted to determine the impact of two varieties of barley (white and black), seed coverage (5-10 and 10-20) cm, with sowing method (seed drill, conventional and overlapped seed broadcasting), on green yield and yield components during two successive winter season (2022-2023 and 2023-2024). Using split-split plot design with three replications, in Sulaimaniyah. The result indicated the superiority of the white variety in all characteristics at both seasons compared to the black variety. The seed coverage (10-20) cm was found to be the best for almost all studied characteristics. Regarding the sowing method, it was found that using a seed drill showed superiority for the studied characteristics compared to other methods. It was observed that the second season exceeded the first one in most characteristics.

***Keywords*:** Seed drill, seed coverage, overlap broadcasting, Harvest index.

INTRODUCTION

Globally, barley is considered one of the first domesticated plants and continues to play a major role in the development of modern agriculture to this day for human and animal nutrition. It also has important benefits in the fields of plant genetics, physiology, biotechnology, and plant diseases, and is the primary purpose of barley cultivation. Barley also has many other uses, such as alcoholic beverages and the use of its straw as animal bedding [1]. Due to the many challenges facing barley cultivation, such as poor germination and growth, which affect the final product, finding suitable varieties and using appropriate cultivation patterns is a priority for good agriculture that must be taken into account under the conditions available in a given region [2]. Considering the type of seeds and their characteristics, planting date, and the physical properties of the soil, planting the seeds at a suitable and equal depth for all seeds and covering them completely are among the main factors affecting the increase in crop productivity [3]. Seed coverage at a sufficient depth and with good mulch ensures that birds and mice do not disturb or eat the seeds [4]. Barley is considered one of the winter crops commonly grown in mountainous regions with a temperate climate, as it is grown annually around the world due to its ability to adapt to different climatic conditions [5]. The management of crop breeding and improvement techniques has an influential role in increasing the annual yield by a percentage that may range between 0.8% and 1.2% [6]. The geographical location of Iraq can be considered a region with varying temperatures, as it is characterized by a dry climate in the summer with high temperatures, and a rainy climate in the winter with accompanying coldness [7].In general, rainfall in Iraq is characterized by fluctuation and irregularity in terms of rainfall time and quantity, which are two characteristics that change from one year to another, which can significantly affect crop growth and productivity [8]. In general, maintaining soil effectiveness and preventing its degradation remains the desired goal of good soil management, which includes tillage operations [7] Planting seeds with a seed drill aims to place the seeds in the soil at equal distances to ensure homogeneous distribution of the seeds, equal access to nutrients and water, good and even coverage of the seeds for better seed germination and higher yield. While, the lack of using a seed drill are that it is an expensive process and requires more manpower and constant maintenance of the machine parts, unlike using a seed distributor, which is widely used by farmers in cultivating their lands [9]. Planting with a seed distributor means spreading and distributing the seeds on the field in a random, irregular manner. [10]. indicated that the proper use of seed drills results in good seed distribution with good soil contact, which has a strong impact on germination time. It was also noted that a disadvantage of using seed broadcasting is the failure to ensure optimal seed-soil contact, even when covered with harrowing equipment. This reduces the seed's ability to absorb a sufficient amount of water necessary for growth [11]. In an experiment conducted by compare the performance of different planting machines on wheat yields, they found that seed drills save approximately 26% of the seeds compared to conventional sowing by spreading machines. confirmed that evenly spaced seeds significantly impacts crop yields. indicated which that alternative methods of using seed spreaders to achieve more precise seed distribution can make the planting process more acceptable, taking into account the overall agricultural economic conditions [12, 13]. Although soil has a significant influence on the physiological behavior of the soil, inhomogeneous seed distribution leads to significant waste of money [14]. The pattern of seed distribution on the ground is the primary criterion for the quality of the planting process when using seed spreaders [15]. To avoid inappropriate seed distribution, spreaders should be driven in somewhat overlapping paths of the spreading lines to avoid leaving untreated lines [16]. Farmers widely sow wheat and barley seeds by using a seed spreader machine because it is a fast, economical, and effortless method [9]. The traditional method involves randomly scattering grains. It is well known that random scattering means inconsistent seed distribution on the soil surface, as the ejection of the grains depends on the weight and shape of the grain, in addition to the machine's movement position during operation. Furthermore, a drawback of this machine is that the percentage of grains ejected from the machine's scattering disc is higher in areas close to the disc than further away we are from the disc, because the ejection principle depends on the centrifugal force of the disc's rotation. In addition, machine operators sometimes leave untreated areas due to the operator's failure to focus on the scattering lines, as they rely solely on the traces of the tractor's wheels moving back and forth across the field. In many cases, areas up to 2 meters wide are treated twice in the field. The researchers added that all this variation in grain distribution affects the distribution pattern on the soil surface, which in turn affects the variation in yield, both quantitatively and qualitatively, from one area to another. [17]. indicated that the solution to the problem of uneven seed distribution in a centrifuge is to spread half the seeding rate backward and half vertically over the same area. However, The distribution technique is not preferred for solving the problem of uneven distribution[17]. Effective overlap of the spreading lines (30 to 50%) is necessary and effective for achieving an acceptable seed distribution pattern [9]. In a study conducted by [18]. to study the effect of planting depth on the growth and yield of corn, it was concluded that planting of 6, 12, and 18 cm gave a grain yield of 5.8, 6.1, and 5.9 ton ha^{-1} .The experiment aimed to determine the best barley variety for planting at the ideal depth of cover, using the best sowing pattern, and to find the best combination of experimental factors that will lead to increased yield and yield components for forage purpose.

Materials and Methods

The field experiment was conducted across two consecutive winter growing periods, namely, 2022–2023 and 2023–2024, at the Bakrjo experimental fields of the College of Agricultural Engineering Sciences, University of Sulaimani, Sulaymaniyah, Kurdistan Region, Iraq (approximately 35°33′ N, 45°27′ E, approximately 830 m a.s.l.). It is situated at a rainfed cereal producing area featuring cool and wet winters and dry summers. It was then grown in a rainfed field environment so annual rainfall becomes an environmental variation source, as shown in Table 1. Monthly rainfall and air-temperature data for each of the two seasons follow this. Before the sowing in each season, composite samples would be taken from the 0–30 cm soil layer of the experimental field to make a characterization of the seedbed. The soil at the location was silty clay, 48.5 g kg^{-1} sand, 449.8 g kg−1 silt, 501.7 g kg^{-1} clay, bulk density as 1.32 g cm^{-3}, pH as 7.44, EC as 0.33 dS m^{-1}, organic matter as 21.02 g kg^{-1}. Soil moisture at sowing was verified gravimetrically prior to field work, and seed-sowing and cover was performed only when the seeded layer was friable to apply the same mechanical conditions in 2 seasons. Two barley types were used, one for white barley and the other for local black barley. Seed of each cultivar was received locally at one time twice, cleaned and graded up and visually tested to remove broken, under-grown grain during sowing. Physical purity and germination were verified prior to planting, and the rate of planting was the same for all treatments to prevent association with sowing technique or coverage depth with plant density. All cultivars, all sowings methods, and both seasons seed at a steady-state level ratio of 160 kg ha^{-1} were used in both cases. The crop was sown on 20 and 25 November and harvested on 10 June 2023 and 14 June 2024 at physiological maturity and maturity, respectively. Both seasons followed the same types of equipment, sequence of field preparation, and work depth and operating speed. The primary tillage was done with an ITM CO 285, 4WD tractor (65 hp/56 kW) combined with a three-bottom Unlu moldboard plow with forward speed of 6.68 $Km.hr^{-1}$ at a depth of 25–30 cm. Seedbed preparation and seed covering/ incorporation on broadcasted patches was carried out with Unlu field cultivator with spring-loaded duck-foot shanks. Covering operation depth was modified with the application of coverage treatment prescribed, and verified multiple times with a ruler during the operation. In both seasons, tractor forward speed was kept as uniform as possible within the recommended operating range of the implements. A comparison of three different sowing methods was conducted. The first was sow by seed drill with Gil/ Multisem 24-M seed drill (Spain), 3.0 m working width, 25 tine openers, 12 cm row spacing, studded roller metering device, 800 L hopper capacity. The drill was calibrated before the sowing and a similar seed rate was achieved in all plots, and the opener depth and cover devices were tuned for the seed covers treatment applied. The second method was a conventional broadcasting way, using Solano mono-disc seed broadcaster with 800 L hopper capacity (Spain), 18 m nominal swath width, PTO velocity of 540 rpm, and six vanes (three straight and three curved). So, in this method, the whole seed was done in one go. The third method was overlapped broadcasting (as the local tested the overlapping concept for cereal seed distribution). In this method, the same broadcaster was used, but the seed rate delivered in each pass and effective bout width were halved, making two reciprocal passes over the same area with a right-on-right and left-on-left traffic arrangement, resulting in a final seed rate per unit area equal to the other methods as well as improving transverse distribution uniformity. Seed coverage was established immediately after seed distribution for the broadcasted treatments. The two seed coverage treatments (5−10 cm and 10−20 cm) indicated the depth range of soil coverage / cover layer rather than a separate seeding rate treatment. With a cultivator work depth of 5–10 cm and tractor speed of 7.15 km $hr.^{-1}$, the depth is adjusted through adjustment of three-point linkage position and tractor speed. For each operation the resulting depth was verified at a random location in each plot by carefully excavating the seed zone and determined how far vertically from the surface to the covered seed layer it extended vertically. The plot was executed on a fixed implement condition before finishing, if the observed depth came out of the intended range. The experiment was designed as a split-split plot design within a randomized complete block with three replications each season. Barley cultivar was assigned to the primary plots, depth of seeds covered to subplots, and method for planting in sub-subplots. A net area of 18 m × 30 m was used for each experiment. Barley growers had three factors: (A) barley cultivar: white barley and local black barley; (B) seed coverage depth: 5–10 cm and 10–20 cm; and (C) sowing method: seed drill, conventional broadcasting, and overlapped broadcasting. All non-experimental agronomic operations—such as fertilization, weed control, and field protection—were uniform to all plots in the two seasons according to local recommendations for rainfed barley cultivation. Data from the central part of each plot were at maturity collection to avoid border effects. Plant height was measured from the soil surface up to the top of the spike and not awn. Number of grains per plant and number of grains per spike were calculated from randomly selected plants and spikes of each plot that were representatives of participants as well as number of spikes per plot. Spikes per m² plotted using fixed quadrats in the crop area. Thousand grain weight was assessed using clean grain samples. Measures of grain yield and straw yield were recorded from the harvested area per plot and converted into kg ha^{-1}. Agricultural productivity was taken from both the harvest area of each plot and turned into grams for the biological yield, and harvest index was added by the yield on grain weight divided by the biological yield. In interpreting cultivar effects and interactions between cultivars, the genetic nature of both barley varieties was taken into account and variations between cultivars were considered to be genetic and not solely due to sowing techniques, coverage depth or other seasonally conditioned factors. Seasonal data were analysed by using OPSTAT software to analyze a combined analysis across the two seasons. For analysis of variance, the split-split plot format was applied, the replication and season were adjusted to the combined RCBD approach. When treatment effects were observed, means were separated using Duncan's multiple range test at $P \leq 0.05$. These seasonal effects and interactions with the experimental factors were regarded in interpretation because of the differences in rainfall and temperature distribution between them for the two seasons.

Table 1. The research site's temperature and rainfall data in Sulaimani for both season (2022–2023) and (2022–2023)

Month	Season 2022-2023				Season 2023-2024			
	Rainfall	Temperature C^0			Rainfall	Temperature C^0		
	(mm)	Minimum	maximum	Average	(mm)	Minimum	maximum	Average
October	4.6	17.2	28.2	22.9	9.3	16.2	27.7	21.9
November	43.2	10.8	22.1	16.5	78.9	10.7	20.1	15.4
December	39.8	7.5	18.1	12.8	59.1	6.9	16.4	11.7
January	127.3	3.7	11.6	7.6	97.7	5.4	13.4	9.4
February	57.3	11.5	22.3	16.9	196.5	5.1	13.1	9.1
March	250.5	13.8	25.8	19.8	144.6	7.7	17.5	12.6
April	145.1	16.5	28.5	22.5	38.6	15.8	27.2	21.5
May	50.5	17.4	29.5	23.4	99.6	16.3	27.8	22.1
Total	673.3				724.5			

Results and Discussion

Data in table (2) explain differences between varieties at both season and their average, for the studied characters. The differences between varieties were significant for all characters except the number of seeds-plant^{-1}, which was not significant. The white variety exceeded the black one significantly for both season and their average. As the average of both seasons the white variety exceeded by 7.77, 11.63, 12.35, 13.81, 42.54, 28.31, 32.51, and 5.08% for the characters plant height, number of seeds. spike^{-1}, number of spikes/m^2, 1000 grain weight, grain yield, straw yield, biological yield and harvest index. The white barley showed superiority compared to black barley for most characters, while in other research this is the exact poppets of our result [9].

Table 2. Effect of Barley variety on the studied traits.

A Barley variety	Plant Height cm	No. of grains/plant	No. of grains/spike	No. of spike/ m^2	1000 grain weight gm	Grain yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season									
White	79.22 ^{a}	106.2 a	25.50 a	436.45 a	27.99 a	3.119 a	6.577 a	9.696 a	0.320 a
Black (locally)	74.78 ^{b}	103.1 a	22.67 b	385.33 b	24.80 b	2.171 b	5.037 b	7.207 b	0.300 b
Second season									
White	87.7 a	122.8 a	26.5 a	446.0 a	29.6 a	3.515 a	7.634 a	11.148 a	0.310 a
Black (locally)	80.1 b	122.9 a	23.9 b	400.1 b	25.8 b	2.484 b	6.038 b	8.523 b	0.290 b
Average of both seasons									
White	83.46 $_a$	114.5 $_a$	26.00 $_a$	441.225 $_a$	28.8 $_a$	3.317 $_a$	7.1055 $_a$	10.422 $_a$	0.318 $_a$
Black (locally)	77.44 $_b$	113.0 $_a$	23.29 $_b$	392.715 $_b$	25.3 $_b$	2.3275 $_b$	5.5375 $_b$	7.865 $_b$	0.295 $_b$

Effect of grain coverage on the studded traits

Data present in table (3) illustrate the effect of grain coverage on studied characters for both seasons and their average. At the first season this effect was significant for the characters plant height, number of spicks/ m2, straw yield and biological yield, confirming the outyielding the treatment of 10-20 over 5-10 significantly. At the second season the effect of grain coverage was significant for only grain yield and harvest index, which exceeded 10-20 0n 5-10 seed coverage. As the average of both seasons the effect of grain coverage was significant on plant height and number of spikes/m2 only. The treatment 10-20 exceeded 5-10 in these characters by 5.78 and 0.93% respectively. While in previous work depth (4 cm) was considerably superior to depth (8 cm) in the characteristic of (1000WG) (37.75 g) and the other traits did not show significant differences between the two planting depths, according to The highest grain yield (2.98 T ha $^{-1}$) was obtained with the Alparslan cultivar sown at a depth of 5 cm [22]. Grain yield of all varieties tested was drastically reduced when sown at depths of 9 cm, with the exception of the local Tir and Alparslan varieties, both of which, when compared to the other varieties tested, had longer coleoptiles [19]. Increasing sowing depths can enhance wheat establishment because of the higher soil-water content in the seed zone, resulting in better germination and emergence of seedlings [19]. There was an overall agreement that the emergence inhibition increases proportionally with the depth of seed burial in the soil [20]. The results of the research indicate that the grain plumpness specified by the weight of 1000 grains was significantly dependent on the sowing depth and size of the seeds. There was no evidence of a significant interaction between the factors and their effect on the weight of 1000 grains. Important differences in the TGW were found between the seed fractions used for sowing. Grains obtained from treatments, in which large and medium seeds were sown, were characterized by significantly greater TGW. According to other studies [21].

Table 3. Effect of grains coverage on the studded traits

(B) Grains Coverage cm	Plant Height cm	No. of grains / plant	No. of grains / spike	No. of spike/ m^2	1000 grain weight gm	Grain Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season									
5-10	73.56 b	103.3 a	23.50 a	406.83 b	26.54 a	2.573 a	5.563 b	8.136 b	0.31a
10-20	80.44 a	106.0 a	24.67 a	414.95 a	26.24 a	2.717 a	6.050 a	8.767 a	0.31a
Second season									
5-10	82.8 a	125.3 a	25.6 a	423.2 a	27.9 a	3.063 a	6.844 a	9.907 a	0.31a
10-20	84.9 a	120.4 a	24.9 a	422.9 a	27.5 a	2.936 b	6.828 a	9.764 a	0.30 b
Average of both seasons									
5-10	78.2 b	114.3 a	24.6 a	415.0 b	27.2 a	2.82 a	6.20 a	9.02 a	0.31 a
10-20	82.7 a	113.2 a	24.8 a	418.9 a	26.9 a	2.83 a	6.44 a	9.27 a	0.30 a

Effect of the sowing method on the Studied traits

Table (4) illustrate the effect of sowing methods on studied characters at both seasons and their average. It was noticed that the effect of sowing methods was significant on all studied characters. At the first season the treatment of seed drill was exceeded both conventional broad casting and overlap broad casting for all characters except straw yield which the treatment of overlap broad casting exceeded the rest and there were not significant differences between seed drill and overlap broadcast for the characters number of seeds/spike and biological yield. Over all using conventional broad casting gave the minimum values for most characters. At the second season it was observed that the maximum values produced by using seed drill while the minimum values were showed by conventional broadcasting, whereas not significant differences were obtained between seed drill and overlap broad casting for the characters plant height and number of grains/spikes. As the average of both seasons using seed drill gave the desirable value for all characters, but not significant with overlap broad casting for the characters plant height, number of grains/spikes, straw yield and biological yield. While in previous work the average results for overlapped seed broadcasting were higher than those of the conventional manner by: 0.8%, 0.3% 1%, 0%, 3.3%, 6.7% and 14.5%. The lowest values were resulted from applying: MB plus seed distributor plus MB, while, the maximum yield was given by applying: cultivator plus seed distributor plus cultivator. The total wheat production was 2809.06 Kg/ha when 7.84 USD/ha spent for applying overlapping mode of seed spreading with an increase of 7.17% than the yield resulted from using conventional method. [9].

Table 4. Effect of the Sowing Method on the Studied Traits

C Sowing methods	Plant Height cm	No. of grains / plant	No. of grains / spike	No. of spike/ m^2	1000 grain weight gm	Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season									
Seed drill	80.75 a	117.8 a	24.67 a	422.17 a	27.35 a	2.876 a	5.686 b	8.562 a	0.33a
Conventional broadcasting	72.25 c	92.8 c	22.42 b	401.08 c	25.64 b	2.322 c	5.790 b	8.112 b	0.28 c
Overlap broadcasting	78.00 b	103.3 b	25.17 a	409.42 b	26.19 b	2.736 b	5.944 a	8.68 a	0.31b
Second season									
Seed drill	86.4 a	134.4 a	26.5 a	433.8 a	29.4 a	3.410 a	7.092 a	10.502 a	0.32 a
Conventional broadcasting	79.8 b	108.3 c	23.7 b	412.3 c	26.2 c	2.577 c	6.699 b	9.276 c	0.28 c
Overlap	85.3 a	125.9 b	25.5 a	423.1 b	27.6 b	3.011	6.717	9.728 b	0.31 b

broadcasting						b	b		
Average of both seasons									
Seed drill	83.58 a	126.10 a	25.59 a	427.99 a	28.38 a	3.14 a	6.39 a	9.532 a	0.33 a
Conventional broadcasting	76.03 b	100.55 c	23.06 b	406.69 c	25.92 c	2.45 c	6.24 b	8.694 b	0.28 c
Overlap broadcasting	81.65 a	114.60 b	25.34 a	416.26 b	26.90 b	2.87 b	6.33 a	9.204 a	0.31 b

Effect of the interaction between Barley variety and grain coverage on the studded variety

The interaction effect between barley variety and coverage present in table (5) at both season and their average. It was observed the effect of this interaction was significant on all studied characters at both seasons and their average. At the first season it was noticed the exceeding of the interaction between white barley and 10-20 seed coverage for all studied characters except harvest index. There were not significant differences between the interaction between white with 10-20 and white with 5-10 for most characters, while the minimum values showed by the interaction between black and 5-10 for most characters. At the second season the interaction between white and 10-20 showed maximum values for most characters, while the minimum values for most characters produced by the interaction between black and both 5-10 and 10-20 coverage. As the average of both seasons the interaction between white barley and both5-10 and 20-10 coverage showed the desirable values, while the lowest values showed by the interaction between black barley and both 5-10 and 10-20 coverage. In previous work the interactions between the black variety with (8 cm) planting depth were significantly superior in the characteristics of (PH) (60.41 cm) and (NS.m2) (495.34), whereas the white variety with an (8 cm) planting depth was significantly superior in the (BY) (597.99 g), (SY) (367.54 g/m2) and (GY) (230.45 g) [22].

Table 5. Effect of the interaction between Barley variety and grain coverage on the studded variety

(A) Barley variety	(B) grains coverage cm	Plant Height cm	No. of grains / plant	No. of grains / spike	No. of spike/ m^2	1000 grain weight gm	Grain Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season										
White	5-10	75.00 bc	108.8 a	24.78 b	433.89 a	28.39 a	3.058 a	6.145 b	9.203 b	0.33 a
	10-20	83.44 a	103.6 a	26.22 a	439.00 a	27.59 a	3.180 a	7.009 a	10.189 a	0.31 b
Black	5-10	72.11 c	97.8 b	22.22 c	379.78 c	24.70 b	2.088 b	4.981 c	7.069 c	0.29 c
	10-20	77.44 b	108.4 a	23.11 bc	390.89 b	24.90 b	2.254 b	5.092 c	7.346 c	0.30 b
Second season										
White	5-10	85.7 a	130.6 a	26.3 a	451.3 a	29.9 a	3.571 a	7.694 a	11.264 a	0.32 a
	10-20	89.7 a	115.1 c	26.7 a	440.7 b	29.4 a	3.459 b	7.573 a	11.032 a	0.31 a
Black	5-10	80.0 b	120.1 bc	24.8 b	395.0 d	25.9 b	2.555 c	5.994 b	8.549 b	0.30 b
	10-20	80.1 b	125.7 ab	23.1 c	405.2 c	25.7 b	2.414 d	6.083 b	8.497 b	0.28 c
Average of both seasons										
White	5-10	80.35	119.70 a	25.54 a	442.60 a	29.15 a	3.31 a	6.92 a	10.23 a	0.32 a
	10-20	86.57 a	109.35 b	26.46 a	439.85 a	28.50 a	3.32 a	7.29 a	10.61 a	0.31 a
Black	5-10	76.06 c	108.95 b	23.51 b	387.39 b	25.30 b	2.32 b	5.49 b	7.81 b	0.30 b
	10-20	78.77 c	117.05 a	23.11 b	398.05 b	25.30 b	2.33 b	5.59 b	7.92 b	0.30 b

Effect of the interaction between barley variety and sowing method on the studded traits

The interaction effect between barley variety and sowing method recorded in table (6) for both seasons and their average for all studied characters. It was noticed that the interaction between white barley with seed drill gave maximum value for the characters plant high, number of spikes/m2, 1000 grain weight, grain yield and harvest index for both seasons and their average, while for number of (grains.plant^{-1}) the maximum value recorded by the interaction between black barley and seed drill at both seasons and their average. But for the characters number of grains/spike, straw yield and biological yield the highest value recorded by the interaction white barley with overlap broadcasting at the first season, while at the second season. The maximum value recorded by the interaction of white barley and seed drill for these characters. At the average of both seasons the highest values for number of grains/spike and straw yield recorded by the interaction of white barley with overlap broadcasting, and for biological yield recorded by white barley and seed drill. The interaction between black barley with conventional broadcasting showed the lowest values for almost all characters at both seasons and their averages.

Table 6 Effect of the interaction between barley variety and sowing method on the studded traits

-	C Sowing method	Plant Height cm	No. of grains / plant	No. of grains / spike	No. of spike/ m^2	1000 grain weight gm	Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
					First season					
White	Seed drill	83.50 a	117.5 a	26.00 b	449.50 a	28.95 a	3.383 a	6.467 b	9.850 a	0.34a
	Conventional broadcasting	73.17 de	92.0 d	23.33 c	425.67 c	27.22 b	2.696 b	6.382 b	9.078 b	0.29d
	Overlap broadcasting	81.00 b	109.0 b	27.17 a	434.17 b	27.80 b	3.279 a	6.882 a	10.160 a	0.32b
Black	Seed drill	78.00 c	118.0 a	23.33 c	394.83 d	25.75 c	2.370 c	4.905 d	7.275 c	0.32b
	Conventional broadcasting	71.33 e	93.7 cd	21.50 d	376.50 f	24.07 d	1.948 e	5.199 c	7.147 c	0.27e
	Overlap broadcasting	75.00 d	97.7 c	23.17 c	384.67 e	24.58 d	2.194 d	5.006 d	7.200 c	0.30c
					Second season					
White	Seed drill	90.0 a	130.8 b	28.0 a	454.0 a	31.1 a	3.957 a	7.892 a	11.850 a	0.33 a
	Conventional broadcasting	83.5 b	107.0 d	24.5 b	437.3 c	28.4 c	3.041 c	7.534 b	10.575 c	0.28 e
	Overlap broadcasting	89.5 a	130.7 b	27.0 a	446.7 b	29.4 b	3.546 b	7.474 b	11.020 b	0.32 b
Black	Seed drill	82.8 b	138.0 a	25.0 b	413.7 d	27.7 d	2.863 c	6.292 c	9.155 d	0.31 c
	Conventional broadcasting	76.2 c	109.5 d	22.8 c	387.2 f	23.9 f	2.114 e	5.863 d	7.977 f	0.26 f
	Overlap broadcasting	81.2 b	121.2 c	24.0 b	399.5 e	25.8 e	2.476 d	5.960 d	8.437 e	0.29 d
					Average of both seasons					
White	Seed drill	86.75	124.15	27.00	451.75	30.03	3.67	7.18	10.85	0.33
	Conventional broadcasting	78.30	99.50	23.92	431.49	27.81	2.87	6.96	9.83	0.29
	Overlap broadcasting	85.25	119.85	27.09	440.44	28.60	3.41	7.18	10.59	0.32
Black	Seed drill	80.40	128.00	24.17	404.27	26.73	2.62	5.60	8.22	0.31
	Conventional broadcasting	73.75	101.60	22.15	381.85	23.99	2.03	5.53	7.56	0.26
	Overlap broadcasting	78.10	109.45	23.59	392.09	25.19	2.34	5.48	7.82	0.29

Effect of the interaction between grain coverage depth and sowing method on the studded traits

Data in table (7) illustrate the interaction effect between grain coverage depth and sowing method on studied characters during both seasons and their average. The interaction of 5-10 with seed drill gave maximum values for number of grains/plants, 1000 grain weight. In the first season, the interaction of 10-20 with the seed drill yielded the maximum values for plant height, number of spikes/m², grain yield, and harvest index. In the second season and the average of both seasons, the interaction of 5-10 with seed drill showed the best values for almost all characters, while the lowest values for most characters were recorded by the interaction between 5-10 and conventional broadcasting.

Table 7. Effect of the interaction between grain coverage depth and sowing method on the studded traits

(B) Grain coverage cm	C Sowing method	Plant Height cm	No. of grains/ plant	No. of grains/ spike	No. of spike/ m^2	1000 grain weight gm	Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season										
5-10	Seed drill	75.17 c	121.7 a	24.33 b	419.50 b	27.63 a	2.855 a	5.717 c	8.572 b	0.33b
	Conventional broadcasting	69.17 d	89.3 e	21.67 d	397.00 d	25.98 bc	2.248 d	5.467 e	7.715 d	0.28 e
	Overlap broadcasting	76.33 c	98.8 d	24.50 b	404.00 c	26.02 bc	2.616 b	5.506 de	8.122 cd	0.31c
10-20	Seed drill	86.33 a	113.8 b	25.00 ab	424.83 a	27.07 a	2.898 a	5.656 cd	8.553 b	0.33a
	Conventional broadcasting	75.33 c	96.3 d	23.17 c	405.17 c	25.30 c	2.396 c	6.114 b	8.510 bc	0.27f
	Overlap broadcasting	79.67 b	107.8 c	25.83 a	414.83 b	26.37 b	2.857 a	6.382 a	9.238 a	0.30d
Second season										
5-10	Seed drill	85.5 ab	144.3 a	27.5 a	435.3 a	29.9 a	3.606 a	7.259 a	10.865 a	0.33 a
	Conventional broadcasting	79.5 c	106.8 c	23.5 c	411.5 c	26.2 d	2.555 d	6.637 b	9.192 e	0.27 d
	Overlap broadcasting	83.5 b	124.8 b	25.7 b	422.7 b	27.7 c	3.028 c	6.636 b	9.663 cd	0.31 b
10-20	Seed drill	87.3 a	124.5 b	25.5 b	432.3 a	28.9 b	3.215 b	6.925 b	10.140 b	0.31 b
	Conventional broadcasting	80.2 c	109.7 c	23.8 c	413.0 c	26.1 d	2.600 d	6.760 b	9.360 de	0.27 d
	Overlap broadcasting	87.2 a	127.0 b	25.3 b	423.5 b	27.6 c	2.995 c	6.799 b	9.793 bc	0.30 c
Average of both seasons										
5-10	Seed drill	80.34	133.00	25.92	427.40	28.77	3.23	6.49	9.72	0.33
	Conventional broadcasting	74.34	98.05	22.59	404.25	26.09	2.40	6.05	8.45	0.28
	Overlap broadcasting	79.92	111.80	25.10	413.35	26.86	2.82	6.07	8.89	0.31
10-20	Seed drill	86.82	119.15	25.25	428.57	27.99	3.06	6.29	9.35	0.32
	Conventional broadcasting	77.77	103.00	23.49	409.09	25.70	2.50	6.44	8.94	0.27
	Overlap broadcasting	83.44	117.40	25.57	419.17	26.99	2.93	6.59	9.52	0.30

Effect of the interaction between Barley variety, grain coverage depth and sowing method on the studded traits

Data in table (8) illustrate the effect of the interaction among barley variety, grain coverage and sowing method on studied characters at both seasons and their average. It was observed that this effect was significant on all characters at both season and their average except harvest index for the average of both season which was not significant. At the first season it was found that the best value for most characters recorded by the interactions of white barley coupled with 5-10 and 10-20 coverage under seed drill, while at the second season the best value for most characters shown by the interaction of white barley interacted with 5-10 grain coverage under seed drill. For the average of both seasons the desirable values were found at the same trend of the first season.

Table 8. Effect of the interaction between Barley variety, grain coverage depth and sowing method on the studded traits

(A) Barley variety	(B) Grain coverage cm	C Sowing method	Plant Height cm	No. of grains/ plant	No. of grains / spike	No. of spike/ m^2	1000 grain weight gm	Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
		First season									
White	5-10	Seed drill	77.67 cd	126.3 a	26.3 b	444.7 b	29.07 a	3.403 a	6.260 c	9.663 bc	0.35a
		Conv. broadcasting	68.67 g	90.3 ef	21.7 gh	426.7 de	28.03 b	2.591 d	5.992 d	8.583 d	0.30ef
		Overlap broadcasting	78.67 c	109.8 c	26.3 b	430.3 d	28.07 b	3.180 b	6.183 c	9.363 c	0.33bc
	10-20	Seed drill	89.33 a	108.8 c	25.7 bc	454.3 a	28.83 a	3.362 a	6.675 b	10.037 b	0.33c
		Conventional broadcasting	77.67 cd	93.8 e	25.0 cd	424.7 e	26.40 c	2.802 c	6.772 b	9.573 c	0.29g
		Overlap broadcasting	83.33 b	108.3 c	28.0 a	438.0 c	27.53 b	3.377 a	7.580 a	10.957 a	0.30de
Black	5-10	Seed drill	72.67 f	117.0 b	22.3 gh	394.3 f	26.20 c	2.307 e	5.173 f	7.480 ef	0.30de
		Conventional broadcasting	69.67 g	88.3 f	21.7 gh	367.3 i	23.93 e	1.905 g	4.942 g	6.847 g	0.27h
		Overlap broadcasting	74.00 ef	88.0 f	22.7 fg	377.7 h	23.97 e	2.052 f	4.828 g	6.880 g	0.29fg
	10-20	Seed drill	83.33 b	119.0 b	24.3 de	395.3 f	25.30 d	2.434 e	4.636 h	7.070 fg	0.34b
		Conventional broadcasting	73.00 f	99.0 d	21.3 h	385.7 g	24.20 e	1.991 fg	5.456 e	7.447 ef	0.26i
		Overlap broadcasting	76.00 de	107.3 c	23.7 ef	391.7 f	25.20 d	2.336 e	5.184 f	7.520 e	0.31d
		Second season									
White	5-10	Seed drill	88.7 bc	146.7 a	28.7 a	462.7 a	31.5 a	4.178 a	7.905 a	12.083 a	0.34 a
		Conv. broadcasting	81.7 f	110.7 f	23.7 ef	441.0 c	28.8 d	3.002 d	7.678 ab	10.680 cd	0.28 f
		Overlap broadcasting	86.7 cd	134.3 c	26.7 b	450.3 b	29.4 c	3.532 c	7.498 bc	11.030 c	0.32 b
	10-20	Seed drill	91.3	115.0	27.3 b	445.3	30.7	3.737	7.87	11.616 b	0.32b

			ab	e		c	b	b	9 a		
		Conv. broadcasting	85.3 de	103.3 g	25.3 cd	433.7 d	28.0 e	3.080 d	7.390 c	10.470 d	0.29 e
		Overlap broadcasting	92.3 a	127.0 d	27.3 b	443.0 c	29.4 c	3.560 c	7.450 bc	11.010 c	0.32 b
Black	5-10	Seed drill	82.3 ef	142.0 b	26.3 bc	408.0 f	28.2 e	3.033 d	6.613 d	9.647 e	0.31 c
		Conv. broadcasting	77.3 gh	103.0 g	23.3 fg	382.0 h	23.6 i	2.107 g	5.596 g	7.703 g	0.27 g
		Overlap broadcasting	80.3 fg	115.3 e	24.7 de	395.0 g	25.9 g	2.524 f	5.773 fg	8.297 f	0.30 d
	10-20	Seed drill	83.3 ef	134.0 c	23.7 ef	419.3 e	27.1 f	2.693 e	5.971 ef	8.663 f	0.31 c
		Conv. broadcasting	75.0 h	116.0 e	22.3 g	392.3 g	24.2 h	2.120 g	6.130 e	8.250 f	0.25 h
		Overlap broadcasting	82.0 ef	127.0 d	23.3 fg	404.0 f	25.8 g	2.429 f	6.148 e	8.577 f	0.28 f
Average of both seasons											
White	5-10	Seed drill	83.19 b	136.50 a	27.5ab	453.7a	30.29 a	3.79a	7.08 b	10.87a	0.34a
		Conv. broadcasting	75.19 ef	100.50 g	22.7efg	433.85 c	28.42 b	2.80e	6.84 c	9.63c	0.29a
		Overlap broadcasting	82.69 b	122.05 c	26.5b	440.3b	28.74 b	3.36c	6.84 c	10.20b	0.32a
	10-20	Seed drill	90.32 a	111.90 e	26.5b	449.8a	29.77 a	3.55b	7.28 b	10.83a	0.32a
		Conv. broadcasting	81.49 bc	98.55gh	25.15 c	429.2c	27.2c	2.94d	7.08 b	10.02b	0.29a
		Overlap broadcasting	87.82 a	117.65 d	27.65 a	440.5b	28.47 b	3.47bc	7.52 a	10.98a	0.31a
Black	5-10	Seed drill	77.49 de	129.50 b	24.3cd	401.15 e	27.2c	2.67ef	5.89 d	8.56d	0.31a
		Conv. broadcasting	73.49 f	95.65h	22.5fg	374.65 g	23.77 f	2.01h	5.27 e	7.28g	0.27a
		Overlap broadcasting	77.15 de	101.65 g	23.7de	386.35 f	24.94 e	2.29g	5.30 e	7.59fg	0.30a
	10-20	Seed drill	83.32 b	126.50 b	24d	407.3d	26.2d	2.56f	5.30 e	7.87ef	0.32a
		Conv. broadcasting	74.00 f	107.50 f	21.8g	389f	24.2f	2.06h	5.79 d	7.85ef	0.26a
		Overlap broadcasting	79.00 cd	117.15 d	23.5def	397.85 e	25.5e	2.38g	5.67 d	8.05e	0.29a

Effect of seasons on studied characters

The effect of seasons on studied characters present in table (9). It was observed that this effect was significant on all characters with the exception of harvest index. The second season predominated the first season in all characters significantly by 9.09, 17.95, 4.63, 2.96, 4.94, 13.38, 17.72 and 16.38% respectively.

Table (9) effect of seasons on studied characters

seasons	Plant Height cm	No. of grains / plant	No. of grains / spike	No. of spike/ m2	1000 grain weight gm	Grain Yield Kg/ ha	Straw yield kg/ha	Biological yield Kg/ha	Harvest index
First season	77.0b	104.63b	24.o85b	410.89b	26.395b	2.645b	5.807b	8.451b	0.31a
Second season	84.0a	122.83a	25.20a	423.05a	27.70a	2.999a	6.836a	9.835a	0.30a

Conclussions

The differences between varieties were significant for all characters except the number of seeds/plants, which was not significant. The white variety exceeded the black one significantly for both season and their average. Increasing sowing depths can enhance wheat establishment because of the higher soil-water content in the seed zone, resulting in better germination and emergence of seedlings. the maximum values produced by using seed drill while the minimum values were showed by conventional broadcasting, whereas not significant differences were obtained between seed drill and overlap broad casting for the characters plant height and number of grains/spikes. As the average of both seasons using seed drill gave the desirable value for all characters, but not significant with overlap broad casting for the characters plant height, number of (grains.spike^{-1}), straw yield and biological yield. While in previous work the average results for overlapped seed broadcasting were higher than those of the conventional manner. At the second season the interaction between white and 10-20 showed maximum values for most characters, while the minimum values for most characters produced by the interaction between black and both 5-10 and 10-20 coverage. As the average of both seasons the interaction between white barley and both5-10 and 20-10 coverage showed the desirable values, while the lowest values were shown by the interaction between black barley and both 5-10 and 10-20 coverage. number of grains/plants, 1000 grain weight. In the first season, the interaction of 10-20 with the seed drill yielded the maximum values for plant height, number of spikes/m², grain yield, and harvest index. In the second season and the average of both seasons, the interaction of 5-10 with seed drill showed the best values for almost all characters, while the lowest values for most characters were recorded by the interaction between 5-10 and conventional broadcasting. the effect of the interaction among barley variety, grain coverage and sowing method on studied characters at both seasons and their average except harvest index.

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تأثير انماط الزراعة على المحصول ومكوناته لصنفين من الشعير في منطقة السليمانية

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الخلاصة

اجريت هذه الدراسة لتقيم اداء صنفيين من الشعير (الابيض والاسود) وتغطية البذور بمستويين (***10-5***و***20-10***) وكذلك طريقة الزراعة باستعمال (الباذرة، النثر التقليدي والنثر المتداخل). باستخدام تصميم القطع المنشقة مرتبين وبثلاث مكررات في السليمانية في موسمين زراعيين متتاليين 2022-2023 و 2023-2024. تشير نتائج هذه الدراسة الى تفوق الشعير الابيض على الشعير الاسود في جميع الصفات المدروسة. وكذلك فان استخدام تغطية (10-20)سم كانت افضل في جميع الصفات المدروسة وكذلك فان استخدام الباذرة كانت افضل بالمقارنة مع الطرق الاخرى في جميع الصفات المدروسة. تشير النتائج بتفوق الموسم الزراعى الثاني في اغلب الصفات مقارنة بالموسم الاول.

الكلمات المفتاحية: الباذرة، تغطية البذور، النثر المتداخل، دليل الحصاد