

Estimation of Some Genetic Parameters of Four Genotypes of Bread Wheat under of Spraying Application of Nano-Potassium

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Annotation: A field experiment were conducted at the second agricultural research and experiment station of the College of Agriculture at the University of Al-Muthanna, which is located in the village of Al Bandar, southwest of Al-Muthanna Governorate. During the winter agricultural season 2022-2023, To find out the effect of spraying three different levels of Nano-potassium fertilizer (0, 1.5, 3 g. L⁻¹) which is symbolized by (K0, K1, K2) on growth characteristics and the yield of four genotypes of wheat (N2, N8 and N12) as well as variety (Aba-99) according to the Randomized Complete Block Design (R.C.B.D) with three replications. the results showed that there were significant differences between the treatments of the genotypes in most of the growth and yield characteristics. The genotype N12 gave the highest average plant height, reaching 84.78 cm, the number of tillers was 8.92 tiller per plant, the weight of a thousand grain was 40.79 (g), the number of grains per spike was 45.27 grains, and the harvest index was 30.82%, while the variety Aba 99 excelled in flag leaf area of the, reaching 34.38 cm².

As well as there were significant

differences between the levels of potassium in most of the growth characteristics obtained, where the K2 level gave the highest average plant height, reaching 87.18 cm, the flag leaf area was 34.38 cm², the number of tillers per plant was 9.00 tiller, length of spike which was 11.30 cm, the weight of a thousand grain was 41.08 (g), and the number of grains per spike 49.94, the yield is 4.73 tons per hectare, and the biological yield is 18.64 tons per hectare.

While the results indicated significant differences for interaction between genotype and potassium levels in most of the growth characteristics obtained, as the (K2 × N12) treatment excelled in plant height of 92.08 cm, number of tillers per plant 10.78, weight of a thousand grains 48.38 (g), number of grains per spike 54.47 grains, and grain yield of 5.75 tons. Per hectare and harvest index 30.30%.

As for broad sense heritability, the traits gave highest percent they are the flag leaf area, the number of tiller per plants, the number of grains per spike, the plant height and the harvest index, whose heritability reached (99.15, 97.30, 96.40, 92.24 and 77.57) respectively, Which can be adopted as a selection function to improve the genetic compositions under study

Keywords: Wheat, Nano-Potassium, Genotypes, genetics parameters.

Introduction:

The wheat crop, *Tritium aestivum* L. is one of the strategic crops, as it ranks first among cereal crops in Iraq and the world in terms of importance and the cultivated area. The cultivated area in Iraq has reached to 1.582 thousand hectare, and the production amounted to 4,343,000 tons, with a yield rate of 4.744 ton ha⁻¹ (central Statistical Organization, 2019). The agricultural systems provide food and improve the sources of livelihood and income for a large number of the population, especially since the number of people in the world is increasing and may reach 9 billion in the year 2050, in addition to changes in financial and economic policies as well as changes in climatic, environmental conditions and wars, that is requires to be continuously improved (Pinstrup, 2012).

In order to increase the production of this crop, we need to boost its efficiency using modern technology, such as Nano-fertilizer technology, employing this technology in agriculture, and improving production per unit area (Al-Ramadi, et al., 2016). Nano-fertilizers play an important role in increasing the ability of crops to withstand different stress conditions and increase the resistance of crops to diseases as well as maintaining the genetic characteristics required for different agricultural crops and increasing the active substances in plants. For its easy entry into

cells, in addition to its contribution to transporting compounds to the target places, whether leaves, roots, fruits, or the rest of the plant parts, as well as metabolic processes by increasing the activity of photosynthesis processes by increasing the chlorophyll content in the leaves (Bao-Shan, et al., 2004).

Knowing the plant's nutrient requirements is done by tracing the stages of its fragmentation during the different growth stages and by adopting growth metrics during the plant's growth stages. A plant's production capacity depends on the process applied to it, according to the correct scientific foundations and appropriate environmental conditions, in addition to nutrients as one of the most important factors in meeting the needs of the plant from these elements, especially the major elements nitrogen, phosphorous and potassium which the plant needs and cannot complete its life cycle without. Among the major nutrients in plant nutrition, potassium helps plant roots grow and plays an important role in each of the stages of growth and reproduction as well as It has an effective effect on many vital activities, such as cell division and expansion and activation of many important enzymes in carbohydrate metabolism, nitrate reduction, pollen tube growth, and it also increases the seed weight and size as well as yield quality, which ultimately increases productivity (Malvi, 2011). Its purpose was to determine the effects of spraying Nano-fertilizers with potassium on the growth, yield, and yield components of wheat genotypes.

Material and methods:

During the winter agricultural season 2022-2023, a field experiment were conducted at the second agricultural research and experiment station of the College of Agriculture at the University of Al-Muthanna, which is located in the village of Al Bandar, southwest of Al-Muthanna Governorate. To find out the effect of spraying three different levels of Nano-potassium fertilizer (0, 1.5, 3 g. L⁻¹) which is symbolized by (K0, K1, K2) on growth characteristics and the yield of four genotypes of wheat (N2, N8 and N12) as well as variety (Aba-99),

The experiment was conducted by dividing the field into experimental units with an area of (2 x 2 m²), and the factorial treatments were planted on them randomly according to spilt plot experiment's method using a randomized complete block design (RCBD) with three replications.

The general authority provided seeds for crops Research- Ministry of Agriculture and distributed to the experimental units, which included 10 lines, with a length of 2 meters for each line, and a distance of 20 cm between lines.

The seeds were sown with a seed rate of 120 kg ha⁻¹. Before planting, phosphate fertilizer was added in the form of P₂O₅ 46% at an amount of 100 kg ha⁻¹, and urea fertilizer (N 46%) at 120 kg ha⁻¹ in the first four batches (emergence, branching, elongation, and boot) Jadoua and Saleh, 2013. Irrigation and weeding were carried out according to the needs of the plant. In the days to 75% flowering stage, some growth characteristics were calculated as an average for ten plants chosen randomly, which are the plant height (cm) and the area of the flag leaf (cm²), while, at the stage of physiological maturity, the number of tillers per plant, the length of the spike, the number of grains per spike, the weight of a thousand grains (g), the grain yield from an area of 2 m² and then converted to ton ha⁻¹, the biological yield ton ha⁻¹, and the harvest index were calculated.

Table 1. Some physical and chemical properties of field soil before planting.

Items	Value	Unit
pH	7.10	
ECe	1.40	dsc.m
Organic Mater	0.80	%
Available nitrogen	12.50	mg.kg ⁻¹ soil
Available phosphorus	8.70	

Available potassium		200.00	
Soil properties	Clay	10.00	mg.kg ⁻¹ soil
	Silt	77.00	
	Sand	13.00	
Soil texture		Silty loam	

The data collection, it was classified, arranged and analyzed statistically according to the statistical program (Genstat version 5) and a comparison of the averages, which conducted at the probability level of 0.05. Estimation the phenotypic, genotypic and environment variation between the yield and its components traits (Walter, 1975).

Estimation of Phenotypic and Genotypic coefficient of variation (PCV and GCV)

The phenotypic and genotypic coefficient of variation was computed as per Burton and Dewane (1953) for low moisture stress.

$$PCV (\%) = \frac{\sigma_P}{\bar{X}} \times 100$$

$$GCV (\%) = \frac{\sigma_g}{\bar{X}} \times 100$$

Where,

σ_P = Phenotypic standard deviation

σ_g = Genotypic standard deviation

\bar{X} = Grand mean of character

PCV = Phenotypic coefficient of variation

GCV = Genotypic coefficient of variation

PCV and GCV which classified according to Robinson et al., (1949). 0 -10% was considered as low, 10-20% as moderate and 20% and above as high.

Heritability (%)

Broad sense Heritability estimate as percent mean which calculated using the formula (Hanson et al., 1956).

$$h^2(\%) = \frac{V_g}{V_p} \times 100$$

Where,

$h^2\%$ = Heritability percentage

V_g = Genotypic variance

V_p = Phenotypic variance

Heritability percentage was categorized as follows (Robinson et al., 1949)

0 to 30 per cent was considered as low,

Results and discussion:

Effect of genotypes on some growth, yield and its components.

The results of Table 2 and statistical analysis showed that there were significant differences between the treatments of the varieties in most of the growth and yield characteristics. The genotype N12 gave the highest average plant height, reaching 84.78 cm, the number of tillers per plant was 8.92, the weight of a thousand grain was 40.79 gm, the number of grain was 45.27

grains, and the harvest index was 30.82%, while the cultivar of Aba 99 was superior in flag leave area, reaching 34.38 cm².

Genotypes differ in the length of spike, which is due to the difference in their genetic nature, which was reflected in the difference in their response to the surrounding environmental conditions and consequently their difference in the yield and its components. This result was in agreement with (Baqir and Al-Naqeeb 2018).

Table 2: effect of genotype on some of growth, yield and its components.

Genotypes	Plant height (cm)	Flag leave area (cm ²)	No. of tillers per plant	Length of spike (cm)	Weight of 1000 grains (gm)	No. of grains per spike	Yield of grain (ton. h ⁻¹)	Biological yield (ton. h ⁻¹)	Harvest index (%)
N2	75.63	24.66	6.60	10.84	38.13	36.14	4.12	16.69	25.04
N8	80.06	33.06	7.68	9.84	33.14	41.68	3.53	18.27	19.44
N12	84.78	32.13	8.92	9.98	40.79	45.27	4.84	15.73	30.82
Aba-99	77.11	34.38	8.30	9.35	33.74	42.93	4.24	14.50	29.39
Lsd (0.05)	2.306	0.806	0.320	0.321	1.347	1.487	ns	ns	5.250

Effect of potassium on some growth, yield and its components.

The results of table 2 showed significant differences of spraying of potassium on growth trait, the treatment of K2 spraying gave the highest average plant height, reaching 87.18 cm, the flag leaf area was 34.38 cm², the number of tillers per plant was 9.00 tillers, length of spike which was 11.30 cm, the weight of a thousand grains was 41.08 gm, and the number of grains per spike 49.94 grain, the total yield was 4.73 tons per hectare, and the biological yield which given 18.64 tons per hectare. Where as the harvest index was non-significant.

increasing potassium and antioxidants, maintaining the chlorophyll content and this was reflected in maintaining the swelling and elongation of cells positively (Al-Bourky *et.al*, 2021) and The reason for this may be due to the action of potassium in the vital functions within the plant, the metabolic processes of carbohydrates and proteins, the regulation of the control of the activities of essential nutrients, as well as the prolongation of the period of time. Filling the grains, increasing the efficiency of converting light energy into chemical energy, and increasing the efficiency of transferring the products of the photosynthesis process from the leaves to the places where they are stored in the grains. Hussein, (2012).

Table 2: effect of potassium on some of growth, yield and its components.

Genotypes	Plant height (cm)	Flag leave area (cm ²)	No. of tillers per plant	Length of spike (cm)	Weight of 1000 grain (gm)	No. of grains per spike	Yield of grains (ton. h ⁻¹)	Biological yield (ton. h ⁻¹)	Harvest index (%)
K0	71.22	26.86	6.93	8.87	31.73	33.24	3.62	14.34	25.72
K1	79.78	31.93	7.69	9.84	36.54	41.34	4.20	15.91	26.98
K2	87.18	34.38	9.00	11.30	41.08	49.94	4.73	18.64	25.83
Lsd (0.05)	1.961	1.019	0.261	0.304	0.533	1.053	0.168	1.849	ns

Effect of interaction genotypes and potassium on some growth, yield and its components.

The results in (Table 3) indicated the significant differences for interaction between genotypes and spraying of potassium in most of the growth traits, the treatment combination (N12 × K2) was superior in plant height, number of tillers per plant, weight of thousand grains, number of

grains per spike and total grain yield and harvest index, which were (92.08 cm, 10.78 tillers, 48.38 gm, 54.47 ton h⁻¹, 5.75 and 30.30 %) respectively. Where as the treatment combination (Abaa 99 × K2) which was significant for flag leave area 38.19 cm².

Table 3: effect of interaction between genotypes and potassium concentration on some of growth, yield and its components.

Genotypes	Potassium Concentration (g. L ⁻¹)	Plant height (cm)	Flag leave area (cm ²)	No. of tillers per plant	Length of spike (cm)	Weight of 1000 grains (gm)	No. of grains per spike	Yield of grain (ton. h ⁻¹)	Biological yield (ton. h ⁻¹)	Harvest index (%)
N2	K0	70.33	20.96	6.01	9.87	35.38	29.20	3.82	15.22	25.66
	K1	73.67	24.27	6.41	10.67	38.00	34.80	4.11	16.21	25.54
	K2	82.89	28.77	7.39	11.98	41.01	44.41	4.44	18.63	23.93
N8	K0	69.67	30.27	6.62	8.80	30.90	31.80	3.27	15.72	20.73
	K1	82.00	34.00	7.52	9.87	31.34	43.93	3.35	17.90	18.78
	K2	88.51	34.91	8.90	10.84	37.17	49.32	3.97	21.18	18.82
N12	K0	74.33	26.93	7.50	8.77	30.00	35.13	3.55	13.20	27.00
	K1	87.91	33.80	8.47	9.75	44.00	46.20	5.21	14.97	35.17
	K2	92.08	35.67	10.78	11.42	48.38	54.47	5.75	19.00	30.30
Aba-99	K0	70.54	29.30	7.57	8.03	30.65	36.82	3.86	13.21	29.50
	K1	75.56	35.66	8.36	9.08	32.82	40.41	4.13	14.56	28.42
	K2	85.23	38.19	8.95	10.94	37.76	51.56	4.75	15.73	30.26
Lsd (0.05)		3.692	1.772	0.498	ns	1.483	2.107	0.914	ns	4.416

Genetics parameters for genotypes:

The phenotypic and genotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were estimated in Table (4). The traits showed that harvest index (36.74 and 32.34), flag leaf area (24.40 and 24.29), and number of tillers (21.90 and 21.93), respectively. The values of the phenotypic and genetic coefficient of variation were high, while the trait of plant height recorded low values of (9.04 and 8.68). While the traits (spike length, grain yield, biological yield and weight of thousand grain) recorded high values for the phenotypic coefficient of variation (PCV) which reached (33.36, 27.06, 26.71 and 23.91), while the values of the genotypic coefficient of variation were medium for the traits (grain yield and thousand grain weight which reached (19.44 and 17.25) respectively, and low for the traits (spike length and biological yield) which reached (10.63 and 9.99) respectively, Moreover, a narrow difference was observed between PCV and GCV in some traits which indicates that the effect of the environment on these traits was less.

The heritability estimates also showed that most of the traits recorded higher inheritance in Table (4). They are the flag leaf area, the number of tiller per plants, the number of grains per spike, the plant height and the harvest index, whose heritability reached (99.15, 97.30, 96.40, 92.24 and 77.57) respectively, While the other traits recorded a decrease in the heritability, indicating that although the traits are the least affected by environmental influences, the selection and improvement of these traits may not be beneficial. Because broad-meaning inheritance depends on the total genetic variance that includes both fixable (additive) and non-additive (dominant and superior variance) differences.

Table 4: Estimating genetics parameters for genotypes.

Traits	σE	σP	σG	Heritability	PCV	GCV
Plant height (cm)	4.00	51.46	47.47	92.24	9.04	8.68
Flag leave area (cm ²)	0.49	57.43	56.94	99.15	24.40	24.29
No. of tillers per plant	0.08	2.97	2.89	97.30	21.90	21.93

Length of spike (cm)	10.00	11.13	1.13	10.17	33.36	10.63
Weight of 1000 grains (gm)	36.45	75.98	39.53	52.03	23.91	17.25
No. of grains per spike	1.66	46.15	44.49	96.40	16.37	16.07
Yield of grain (ton. h⁻¹)	0.62	1.28	0.66	51.54	27.06	19.44
Biological yield (ton. h⁻¹)	16.30	18.95	2.65	13.96	26.71	9.99
Harvest index (%)	20.72	92.39	71.67	77.57	36.74	32.34

Conclusion:

We conclude the increase in grain yield under spraying with nano potassium is due to the increase in the absorption efficiency of nanoparticles of potassium due to their small size, thus it can be an effective strategy to increase crop productivity and improve production quality, and this was confirmed by the results of genetic analysis through the high heritability of some of the studied traits, especially the genotypes with high harvest index and moderate plant height, which should be emphasized during selection to improve grain yield. Therefore, the selection of wheat genotypes with high harvest index while simultaneously considering moderate plant height, flag leaf area and thousand-grain weight is a basic condition to achieve improvement in wheat grain yield.

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