IMPACT OF NANO NPK FERTILIZERS TO CORRELATION BETWEEN PRODUCTIVITY, QUALITY AND FLAG LEAF OF SOME BREAD WHEAT VARIETIES

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ABSTRACT

This research was carried out at the fields of Field Crops Dept. Coll. of Agric. Univ. of Baghdad, during the season 2017-2018, to investigate the effect of Nano fertilizer NPK (Fn1, Fn2, Fn3: spraying with the liquid fertilizer 20%-9%-10% with 15% concentration of the levels 750:90:600, 500: 60: 400 and 250: 30: 200 mg L^{-1} and Fgn1, Fgn2, Fgn3: spraying the liquid fertilizer at 7.50% concentration of the same levels plus 50% of the soil Fertilizer) on flag leaf area, grain yield and some of the quality traits of three wheat varieties. Using randomized complete block design with split plot arrange with three replications. The results showed increases in grains yield (48.99%), protein percentage (27.24%), gluten ratio in flour (58.45%) and flag leaf area (38.69%), its dry weight (41.89%) , total chlorophyll content (18.33%), nitrogen (19.37%), phosphorus (44.11%) and potassium (12.03%) when fertilized with Fn1 treatment compared with the control treatment (Fg: soil Fertilizer 184 N, 39.56 P, 41.50 K kg ha^{-1}). The Fgn1 and Fgn2 treatments gave increase in the specific weight of flag leaf at 31.38 and 11.44% respectively, also the Fgn1 and Fgn2 treatments increase in grain carbohydrate content at 15.00 and 10.55 % respectively compared with Fg treatment. Arrangement of the Fertilizers treatments in their general progressively positive effects on growth, yield and quality parameters was Fn1>Fgn1>Fn2>Fgn2> Fn3>Fgn3>Fg. The Bhoth-158 variety gave the highest grains yield (5.25 tons ha^{-1}) with increase ratios 13.14 and 23.82% compared with Uruq and IPA-99 varieties. The IPA-99 was superior in its flour content of highest ratio of the dry gluten (16.99%). The Bhoth-158 variety showed positive response to Nano Fertilizers treatments especially the Fn1 treatment followed by IPA-99 variety. There was highly significant correlation between total grains yield and each of the flag leaf area, its dry weight and chlorophyll content, its time staying active and content of nitrogen, phosphorus and potassium.

Key words: nano fertilization, varieties, chlorophyll, grains yield, *Tritium aestivum* L.
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تأثير سماد NPK النانوي على الارتباط بين الإنتاجية والنوعية ومساحة ورقة العلم لبعض أصناف حنطة الخبز

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المستخلص

تم إجراء هذا البحث في حقول المحاصيل الحقلية– كلية الزراعة– جامعة بغداد– الجادرية، خلال الموسم 2017–2018 ، لدراسة تأثير إضافة السماد NPK النانوي السائل (10–9–20%) وبتركيز 15% بالمستويات 750:90:600 و500:60:400 و250:30:200 ملغم لتر$^{-1}$ وأعطيت الرموز Fn1 وFn2 وFn3 والرش بالسماد النانوي السائل بتركيز 7.50% لنفس المستويات + 50% من NPK التقليدي لكل منها وأعطيت الرموز Fgn1 وFgn2 وFgn3 بالتتابع في مساحة ورقة العلم ، حاصل الحبوب وبعض الصفات النوعية لثلاثة أصناف من الحنطة. باستعمال ترتيب الألواح المنشقة وتصميم القطاعات الكاملة المعشاة بثلاثة مكررات. ازداد حاصل الحبوب بنسبة (48.99%) ونسبة البروتين (27.24%) ونسبة الكلوتين في الطحين (58.45%)، كما ازدادت مساحة ورقة العلم (38.69%) ووزنها الجاف (41.89%) ومحتواها من الكلوروفيل الكلي (18.33%) ومن النتروجين (19.37%) والفسفور (44.11%) والبوتاسيوم (12.03%) عند التسميد بالمعاملة Fn1 بالمقارنة مع المعاملة Fg. وحققت المعاملتين Fn2 وFgn2 زيادة بالوزن النوعي لورقة العلم بنسبة 13.38 و11.44% وكذلك حققت المعاملتين Fgn1 وFgn2 زيادة في محتوى الحبوب من الكاربوهيدرات بنسبة 15.00 و10.55% مقارنة مع المعاملة Fg. وترتبت المعاملات السمادية في تأثيرها الايجابي العام في مؤشرات النمو والحاصل ونوعيته تصاعديا وفقاً للاتي Fn1>Fgn1>Fn2>Fgn2> Fn3>Fgn3>Fg. أعطى الصنف بحوث–158 أعلى حاصل للحبوب (5.25 طن هـ$^{-1}$) وبنسبة زيادة 13.14 و23.82% قياساً بالصنفين أوروك وإباء–99 ، وتفوق الصنف إباء–99 بمحتوى طحينه على أعلى نسبة من الكلوتين الجاف (16.99%). أظهر الصنف بحوث–158 استجابة إيجابية لمعاملات التسميد النانوي سيما المعاملة Fn1 تلاه الصنف إباء–99. اظهر حاصل الحبوب الإجمالي ارتباطاً موجباً عالي المعنوية بصفات مساحة ورقة العلم ووزنها الجاف ومحتواها من الكلوروفيل ومدة بقائها فعالة ومحتواها من عناصر النتروجين والفسفور والبوتاسيوم.

كلمات مفتاحيه: التسميد النانوي، الأصناف، الكلوروفيل، حاصل الحبوب (*Triticum aestivum* L.)
البحث مستل من رسالة ماجستير الباحث الأول

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INTRODUCTION

Developing and applying of new kinds of fertilizers by using Nano technology is considered as one of the active choices, which contributes in increasing wheat production (8). Production of Nano fertilizers and using them as alternative of the traditional fertilizers may promote crops productivity, quality, and many kinds of the macro and micro elements that are needed by plant may present in Nano forms, Nano elements may be used in Fertilizers of many field crops (13,16). The Nano fertilizers compared with traditional characterized by their easy absorption, entering into cells and, improving plant biological functions, Nano have high effect due to their small sizes and the possibility of their Nano particles to join with the ion channels, endocytosis, penetrating into their cell wall (9). encouraging peroxidase and catalase enzymes and inhibiting formation of the reactive oxygen species (ROS) (19,15), besides their high stability at different conditions causing increase of storage ability. Using the Nano fertilizers decreases production costs due to decline of resources, energy consumption, Fertilizers and spraying costs largely. Nano fertilizers emerging as alternatives to conventional fertilizers, build-up of nutrients in soils and thereby eutrophication and drinking water contamination may be eliminated. Nanotechnology improves the nutrient use efficiency and minimize costs of environmental protection. Slow release fertilizers are excellent alternatives to soluble fertilizers. Nutrients are released at a slower rate throughout the crop growth; plants are able to take up most of the nutrients without waste by leaching (10). Abdel-Aziz et al (4) found in their study on bread wheat plants that presence of Nano particles of NPK at diameter ranges between 26.20 and 30.60 Nano meter inside xylem tissue especially in the ethmoid tubes and transferring these particles through xylem tubes at higher averages than the same traditional fertilizer, They referred that all of growth parameters values that were studied after 45, 71 and 96 day from planting and grains yield were the highest in the Nano NPK treatments and they declined in the mineral NPK treatments and it was lowest in control treatment. ano fertilizers applications result encourage the nutrient minerals absorption in plant, it was found in pots experiment in which the Nano phosphorus was sprayed at 0, 0.5 and 1.0 g L^{-1} levels on cotton plants (*Gosypium herbaceum*) that the level 1.0 g L^{-1} resulted increase of percentage of absorption of N, P and K by leave at 115.51, 19.04, 85.11, 15.55, 124.11 and 26.50% respectively compared with 0, 0.5 g L^{-1} level (12). Spraying by complete recommendation of the traditional NPK fertilize plus complete recommendation of the Nano NPK fertilizer on rice plants gave increases in dry weight, plant chlorophyll content and grains yield which were 15.30, 2.72 and 21.27% respectively compared with spraying by complete recommendation of the traditional NPK (5) . Leaves of sorghum plants (*Sorghum vulgare*) contained A and B chlorophyll and carbohydrate in values were 1.21, 3.58 and 2.91 mg g^{-1} when soil was mixed with 0.00475 g kg^{-1} of the Nano chelated potassium and the increases were 28.72, 18.15 and 3.19% respectively compared with the control treatment (no-addition) (14). Grains yield and protein ratio increased when chickpeas plants (*Cicer arietian*) were sprayed with Nano NPK at three growth stages at rates reached 25.21 and 2.23 mg L^{-1} respectively compared with no addition treatment (6). In aquatic study on alfalfa plants (*Medicago sativa*) Nano K_2SO_4 fertilizer was added at rates 1/4, 1/8 and 1/10 in the complete strength Hoagland (235 mg L^{-1}), the level 1/8 gave the highest phosphorus content in the plant tissues (7) This research was aimed to investigate the efficiency of Nano application of NPK on increase the growth and yield of some wheat varieties.

MATERIALS AND METHODS

A field experiment was carried out at the fields of the Dept. of Field Crops, College of Agriculture, University of Baghdad. The field is located among the latitude 33.22^o north and longitude 44.24^o east and at height 43.10 m from sea surface by using soil having properties which are shows in Table 1. To study the foliar feeding by Nano NPK effect on some of growth parameter and on the physiological properties of flag leaf and their correlation with yield and quality of three bread wheat varieties. randomized complete block design with split plot arrangement using

three replicates. The main factor included seven Fertilizers treatments:

Fg: soil Fertilizers by the traditional NPK fertilizer 400 kg ha^{-1} urea 46% N, 200 kg ha^{-1} tri super phosphate 46% P_2O_5 and 100 kg ha^{-1} K_2SO_4 41.5%K. Fn1, Fn2, Fn3: spraying with the liquid Nano NPK fertilizer 20%-9%-10% with 15% concentration of the levels 750:90:600, 500: 60: 400 and 250: 30: 200 mg L^{-1} and the levels were given the symbols Fn1, Fn2, Fn3 respectively (4). Fgn1, Fgn2, Fgn3: spraying the liquid Nano NPK fertilizer at 7.50% concentration of the levels 750:90:600, 500:60:400 and 250:30:200 mg L^{-1} plus 50% of the traditional NPK fertilizer. The levels were given the symbols Fgn1, Fgn2 and Fgn3 respectively. The second factor represented using three wheat varieties, Uruq, Bhoth-158 and IPA-99. Seeds were planted in 15/11/2017 within experimental units and each unit had 4 m^2 areas. Fourteen rows were used and each rows had 2 meter length and the distance between rows were 15 cm with leaving one meter distance between the main treatments and the replicates Nitrogen was added as urea 46%N to the soil in three doses, at start of each of tiller stage (ZGS:21), elongation stage (ZGS:32) and booting stage (ZGS:40) (23), the tri super phosphate was added at one dose in planting, while K_2SO_4 was added after 20 days from seeding emergence.

Table 1. Some physical and chemical properties of the experimental soil

pH		**8.13**
EC (1:1) ds/m		**2.23**
ppm	**N ready**	**35.00**
	P ready	**80.16**
	K ready	**123.01**
	Fe	**23.27**
	Cu	**4.89**
	Zn	**10.44**
	Mn	**12.73**
%	**O.M**	**2.50**
%	**Sand**	**13.20**
	Silt	**54.80**
	Clay	**32.00**
	Texture	**Silty Clay Loam**

The liquid Nano NPK fertilizer was sprayed at early morning on the vegetative part till getting complete wetting and dropping of first drop from plants. Diffuser material was added at 15 ml of washing liquid to each 100 liters water for decreasing the water surface tension and to ensure leave complete wetting. When flowering stage ended, ten plants were selected randomly and the following observation were taken.

Leaf area cm^2: it was estimated by using portable leaf area meter (AM350) for ten leaves and the mean was calculated.

Total chlorophyll content index: it was estimated by using Minolta SPAD 502 device.

Dry weight grams

The specific weight of flag leaf g cm^{-2}: It was estimated from division of weight mean of ten flag leaves by their leaf areas

Time Period of flag leaf remains green day: Ten flag leaves were labeled in the main stems randomly and then the number of days from 100% flowering to green color lost (22).

Content of flag leaf of N, P and K %: Nitrogen was determined by using micro kjeldahl and phosphorus was determined by spectrometer device at wave length 882 Nanometer (17), while potassium was determined by flame photometer device according to method that mentioned by (11).

Grain yield ton ha^{-1}: It was estimated by harvesting two medium rows at 0.60m^2 areas from each secondary experimental unit when the plants reached complete mature stage and the grains yield was calculate and converted to ton ha^{-1} (2).

Protein percentage of grains %: Nitrogen percentage was determined by using the micro kjeldahl device and then the protein percentage of the grains were estimated by using the relation:

Protein percentage of grains % = nitrogen percentage of grains x 5.70 … (21)

Grains carbohydrate percentage %: It was determined by using H_2SO_4 for digestion the sample then phenol and concentrated H_2SO_4 were added. It was determined by spectrometer device at 490 nanometer wave length and then the concentration was recorded from the standard curve (3).

Gluten percentage in the flour %: It was determined according to the method mentioned by (1).

The data were analyzed by using analysis of variance method according to genstat release 10.3 DE program, then the means were compared by using (L.S.D) at 5% probability level (20). The simple correlation coefficient between grains yield and quality with flag leaf properties was found.

RESULTS AND DISCUSSION

Fertilizers treatments and the varieties effected significantly on growth traits (flag leaf area, its dry and specific weights and time of staying active) and some of the physiological characters of the flag leaf (its chlorophyll content and contents of, nitrogen, phosphorus and potassium) Table 2. shows that plants under Fn1 treatments, produced highest of leaf area, stains of the total chlorophyll and dry weight of leave and they had 42.87 cm^2, 48.98 Spad and 0.3800 gram respectively. The plants at the Fn1 treatment produced grains with the highest % of nitrogen, phosphorus and potassium contents in flag leave in which their means 1.54, 0.49 and 2.70% respectively. Both of Fn2 and Fgn2 treatments gave the highest specific weight mean values of the flag leave and they were 9.91 and 9.74 mg cm^{-2}. AS general, average of the treatments may be arranged progressively in their positive effects on flag leaf as follow: Fn1> Fgn1>Fn>Fgn2>Fn3>Fgn3>Fg. Increase of surface area of the Nano particles material, presence of large number of their atoms on the external surface of the vegetative parts and their biological role in promotion activities and reactions of enzymes contributed to increase of their absorption efficiency and increase activity of the catalytic enzymes in ethylene production stoppage and inhibit its work which is known that it has role in chlorophyll. enzyme activity that cause destroy the green plastids and then it affects in lengthiness green plastids activity, increase cells division average and delay of senility of the plant tissues that transfer the mineral nutrient, besides its role in activation of photosynthesis enzymes, which work together in increasing ability of green stains to absorb the visible light of sun rays and convert it to stored chemical energy as organic materials move to plant parts to be used in the different plant functions (9,18). The plants which were under the Fn1 treatment produced the highest grains yield 5.93 ton ha^{-1}, while the treatments Fg , Fn3 and Fgn3 gave less grains yield, which their means were 3.98, 3.79 and 3.66 ton ha^{-1} respectively and they similar significant similarity. It may be noticed that grains yield was close in the Fn2, Fgn1 and Fgn2 from the value of the superior to the values of the low yield treatments, (Table 3). This increase resulted from spraying the plants doses more than the recommended doses of the applied Nano NPK comes from the positive action of the superior treatment in flag leaf area, its dry weight and its chlorophyll stains and NPK contents, (Table 2). These results were agreed with the positive and significant correlation between grains yield characters and the correlation coefficient values were 0.73, 0.69, 0.45, 0.78 and 0.79 respectively (Table 5). The grains produced from the plants under the Fn1 treatment gave highest protein % in the grains 13.59% with increases reached 27.24, 11.02, 35.22, 7.60, 21.88 and 28.93% compared with the treatments Fg, Fn2, Fn3, Fgn1, Fgn2 and Fgn3 respectively (Table 3). The grains contained in the Fng1 and Fng2 had highest carbohydrate% and they were 63.63 and 61.17 % and the two treatments were significantly similar, and this % declined to lowest value at the Fn3 treatment 51.17% and with decline ratio over the two superior treatments reached 19.58 and 16.34% respectively (Table 3). The grains produced from the plants under the Fn1 treatment was superior in wheat flour content of dry gluten compared with the other Fertilizers treatments and the highest medium value was 19.68%, while the Fn3 treatment gave the lowest value 10.65%, the regressive arrangement of the Fn2, Fgn1, Fng2, Fgn1 and Fn2 in gluten content and their values ranged between 16.42-12.42%, (Table 3). Action of the Nano particles is activation of the enzymes metabolism that results increase of nutrient elements movement from adsorption positions to the new growth parts and increase the enzyme and biological reactions and organization hormones work that play role in the influenced factors of photosynthesis as chlorophylls and enzymes built and factors of energy transfer, and encouraging increase of the metabolic materials and the metabolic rates increases in the green plastids and given a speed in construction of the metabolic units as carbohydrates and this movement to the active positions as grains, in addition to that the nutritional fertilizer elements role which works on activation of organic and mineral elements movement and organization of their flowing to the gate (9). Results of the general mean of the fertilizers treatments in grains yield and

quality to advance of fn1 treatment followed by Fgn1>Fn2> Fgn2> Fg> Fgn3> Fn3. Plants of Bhoth-158 variety gave largest flag leaf area and higher potassium and total chlorophyll contents, while IPA-99 variety gave the highest specific weight and longest active stay time and both of these two varieties were significantly similar in flag leaf area and its content of nitrogen and phosphorus (Table 2). Varieties difference in flag leaf area and its growth parameters may be due mainly to genetic ability variability which is reflected on the vegetative and roots parts volume and their efficiency in converting the adsorbed minerals to the active positions and from formation of metabolic materials which may participate in accumulation of dry matter in their leave. The Bhoth-158 variety gave the highest grains yield 5.25 tons ha^{-1} and it was superiored on the grain yield of Uruq and IPA-99 varieties, which they differed significantly between them and they gave mediums value 4.64 and 4.24 ton ha^{-1} respectively. Flour of IPA-99 variety grains contained highest dry gluten ratio 16.99% and it differed significantly in flour content of Uruq and Bhoth-158 varieties grains and they both differed significantly between each other and they gave mediums 11.66 and 14.11 respectively, (Table 3). The varieties variability in their grains yield and its quality correlates with differences in their growth traits and their efficiency in rate of converting the metabolic materials the gates in which they are active. There was significant interaction between the Fertilizers treatments and the varieties in flag leaf area, specific and dry weight, total chlorophyll, potassium parameters and flour content of gluten. The general direction of the interaction treatment values referred that the Bhoth-158 variety appeared clear response of Fertilizers treatments especially the Fn1 treatment followed by the IPA-99 variety and the less response was in Uruq variety (Table 3). Getting agreement state between leaf structure in their porosity number and diameter of these pores with pores of the added Nano compositions reflects on the penetrated quantities of the Nano fertilizer particles into the plant tissue and this affects in their chemical activity appearance in enzyme catalysts of the biological activities inside plant and in turn this ratio reflected on varieties variances in fertilizers application response (18). A significant differences between nano fertilizers and wheat varieties for different characters shows that the response of wheat varieties were differed due to different wheat genotypes.

Table 2. Effected of fertilizers treatments and the varieties as indicators for leaf growth flag

Fertilizers treatments	Flag leaf area cm^2	Dry weight to flag leaf gm	Specific weight to flag leaf mg cm^{-1}	Total chlorophyll spad	The length of the flag leaf is green day	Content flag leaf of nitrogen %	Content flag leaf of phosphorus %	Content flag leaf of potassium %
Fg	**30.91**	**0.2678**	**8.74**	**41.39**	**33.11**	**1.29**	**0.34**	**2.41**
Fn1	**42.87**	**0.3800**	**8.89**	**48.98**	**34.78**	**1.54**	**0.49**	**2.70**
Fn2	**36.82**	**0.3611**	**9.91**	**46.61**	**33.89**	**1.42**	**0.43**	**2.57**
Fn3	**35.27**	**0.2956**	**8.42**	**45.69**	**32.22**	**1.35**	**0.35**	**2.45**
Fgn1	**37.96**	**0.3533**	**9.31**	**48.43**	**34.33**	**1.46**	**0.46**	**2.61**
Fgn2	**35.73**	**0.3478**	**9.74**	**46.09**	**33.44**	**1.38**	**0.39**	**2.49**
Fgn3	**33.05**	**0.2989**	**9.11**	**45.63**	**32.89**	**1.37**	**0.38**	**2.45**
LSD 0.05	**0.59**	**0.0124**	**0.36**	**0.53**	**N.S**	**0.021**	**0.008**	**0.027**
Varieties								
Uruq	**35.86**	**0.3043**	**8.48**	**46.26**	**26.00**	**1.37**	**0.39**	**2.52**
Bhoth-158	**37.89**	**0.3400**	**9.00**	**49.19**	**34.90**	**1.42**	**0.41**	**2.54**
IPA-99	**34.51**	**0.3433**	**9.99**	**42.91**	**39.67**	**1.42**	**0.41**	**2.52**
LSD 0.05	**0.58**	**0.0095**	**0.33**	**0.30**	**0.63**	**0.019**	**0.006**	**0.008**

Table 3. Effected of fertilizers treatments and the varieties for, grain-crops, protein in grains, gluten in the grain flour, carbohydrates in grain

Fertilizers treatments	grain yields ton ha^{-1}	Protein in grains %	Gluten in the grain flour %	Carbohydrates in grain %
Fg	3.98	10.68	12.42	55.33
Fn1	5.93	13.59	19.68	56.50
Fn2	5.34	12.24	16.42	58.33
Fn3	3.79	10.05	10.65	51.17
Fgn1	5.42	12.63	14.18	63.63
Fgn2	4.85	11.15	13.53	61.17
Fgn3	3.66	10.54	12.90	53.97
LSD 0.05	0.55	0.74	0.55	2.69
Varieties				
Uruq	4.64	11.28	11.66	55.24
Bhoth-158	5.25	11.55	14.11	56.96
IPA-99	4.24	11.83	16.99	59.27
LSD 0.05	0.23	Ns	0.15	Ns

Table 4. Effect of interaction between fertilizers coefficients and varieties in the studied traits

Fertilizers treatments	Varieties	Flag leaf area cm^2	The dry weight of the flag leaf gm	Specific weight of the flag leaf mg cm^{-2}	Total chlorophyll spad	Content flag leaf of potassium %	Gluten in the grain flour %
Fg	Uruq	25.90	0.2333	9.01	41.13	2.40	9.98
	Bhoth-158	35.23	0.2600	7.39	42.50	2.40	12.92
	IPA-99	31.60	0.3100	9.81	40.53	2.43	14.37
Fn1	Uruq	40.57	0.3567	8.80	49.27	2.70	16.23
	Bhoth-158	46.86	0.3967	8.47	50.50	2.70	18.38
	IPA-99	41.18	0.3867	9.39	47.18	2.69	24.43
Fn2	Uruq	39.34	0.3500	8.90	45.33	2.57	11.78
	Bhoth-158	38.74	0.3600	9.29	49.77	2.61	16.43
	IPA-99	32.38	0.3733	11.53	44.73	2.53	21.03
Fn3	Uruq	36.17	0.2367	6.54	43.90	2.44	9.57
	Bhoth-158	37.02	0.3367	9.10	50.87	2.46	9.82
	IPA-99	32.61	0.3133	9.61	42.30	2.45	12.57
Fgn1	Uruq	37.92	0.3667	9.67	50.03	2.61	12.40
	Bhoth-158	37.92	0.3333	8.80	50.10	2.64	13.50
	IPA-99	38.04	0.3600	9.47	45.17	2.59	16.65
Fgn2	Uruq	36.17	0.3400	9.40	48.13	2.48	11.15
	Bhoth-158	35.81	0.3567	9.97	50.17	2.49	14.50
	IPA-99	35.21	0.3467	9.86	39.97	2.50	14.95
Fgn3	Uruq	34.94	0.2467	7.06	46.00	2.43	10.50
	Bhoth-158	33.66	0.3367	10.00	50.40	2.46	13.25
	IPA-99	30.55	0.3133	10.26	40.48	2.46	14.95
LSD 0.05		1.36	0.0234	0.79	0.80	0.031	0.62

Table 5. The simple correlation coefficient of the studied traits

Qualities	flag leaf area cm^2	The dry weight of the flag leaf gm	Specific weight of the flag leaf mg cm^{-2}	total chlorophyll spad	The length of the flag leaf is green day	Content flag leaf of nitrogen %	Content flag leaf of phosphorus %	Content flag leaf of potassium%
grain yields ton ha^{-1}	0.76**	0.77**	0.15	0.54**	0.28*	0.74**	0.79**	0.78**
Protein in grains %	0.68**	0.76**	0.22	0.39**	0.27*	0.87**	0.93**	0.93**
Gluten in the grain flour%	0.36**	0.67**	0.46**	0.08	0.66**	0.75**	0.72**	0.62**
Carbohydrates in grain%	0.19	0.58**	0.48**	0.07	0.44**	0.41**	0.56**	0.44**

The correlation coefficient value at the probability level is 0.05 and 0.01 = 0.25 and 0.32 respectively

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