International Journal of Modern Developments in Engineering and Science
Volume 1, Issue 7, July 2022
https://www.ijmdes.com | ISSN (Online): 2583-3138

Soil Characteristic Features and Availability of Nutrients Under Various Fertilization Strategies in Wheat

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***Abstract*: A pot experiment was conducted at the Lovely Professional University, Phagwara to study soil characteristic features and availability of nutrients under various fertilization strategies in wheat. Four varieties were examined named as PBW725, HD3086, HD2967 and PBW677 under various forms of fertilizers. Treatments were control (No NPK and organic fertilizer), 100% NPK, 100% organic fertilizer and NPK + organic fertilizer (50% + 50%). The height and number of leaves were recorded at 45, 60 and 90 days after sowing whereas tillers were recorded at 45 and 60 days after sowing. Yield parameters were also recorded after the harvesting of crop. The iron and protein content was also estimated in the wheat grain. Among all the fertilizers tested 50% NPK and 50% organic fertilizers was found most effective in increasing the height, number of leaves, and number of tillers, grain weight, straw weight, Fe content and protein content. Variety HD3086 was found best amongst all and responded well under applied fertilizers. All the parameters like height, number of leaves, number of tillers, grain weight, straw weight, iron content and protein content were significantly increased by the application of both 50% NPK + 50% organic fertilizer.**

***Keywords*: NPK fertilizers, farmyard manure, availability of iron and protein, soil characteristics.**

1. Introduction

Wheat is a universal staple food broadly cultured for its seed, a cereal grain. The genus Triticum is made of lots of species of wheat; common wheat (*T. aestivum*L.) is mainly used and commonly cultivated. The wheat kernel is a sort of fruit which botanically known as caryopsis. The area for the Wheat crop cultivation is more as compare to food crop as well as any supplementary cereal (220.4 million hectares, 2014). Global trade is superior for wheat than all other productive crops collectively. As wheat was second most produced crop after maize and having world production 749 million tones, in 2016. The wheat has fine, unique and adhesive characteristics of gluten proteins that increase the demand for it, globally. These properties of wheat help in the manufacturing of processed products. In the urban area, its consumption is widely increasing for the diet purposes and industrialization processes. Wheat is a rich and vital source of carbohydrates. Universally, wheat is the most important plant protein for human; it has 13% protein content which is moderately more as compared to other main cereals, relatively less in protein value for supplying very important amino acids. Since wheat is taken as whole grain, it is a basis of many major dietary fiber as well as nutrients.

Soil is a "silent partner" for the farmer. Soil is a source of farming. It supplies water and essential nutrients to plants, physically strengthen plants, helps in management of pests, Regulates the rainfall where it lost by hitting the earth, and protects the air, wildlife and drinking water quality. There are three soil properties as most important with regard to any plant response -related functions, these are; soil pH (to regulate nutrient availability), texture (to regulate water transmission properties and fixation and release of nutrients) and organic matter (to realize the cascading effect on whole range of soil physical as well chemical properties, including the biological properties), and above all, plant traits as well (nutrient capability and nutrient) responsive both.

The fertilizers are used inclusively in inappropriate manner: more fertilization causes environmental pollution in many countries like India, China, Western Europe, North America, even as under utilization it causes soil mining (National Geographic, 2013) in parts of Latin America, Africa and Eurasia. It has been observed that in China, there is more fertilization of N that occurs in the order of11.8 Mt, if it is used on 174 million hac of productive land in sub-Saharan Africa it could potentially double yields (Ju *et al*., 2009; Twomlow *et al*., 2010).

Moreover, the inappropriate ratio of nutrients is there. The diagnostic tools of soil and plants, like quick assessment kits and mobile spectrometers (Shepherd and Walsh, 2007), should recommended to soil type that turn into an important part of fine-tuning fertilizer, and used for aiming the mainly appropriate fertilizer kind to their productive system and regions as channel to producers, traders and users. Though, about new devices more claims are made which quickly evaluate properties of soil, version may come out bulky, the application of data is expected to be crop and environment specific and as properties of soil can be estimated in many ways.

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This depiction calls for methodologies, standardization of data and harmonization. Moreover, there are direct methods to prevent ruining with daunting challenges which are necessary for the evaluation of nutrient contents of fertilizers (Perumal *et al*., 2014).

2. Materials and Methodology

A. Plant Height

Table 1
Effects of NPK and organic fertilizer on the plant height (cm) in wheat

Treatment	45DAS	60DAS	90DAS
V1 Control	14.40^{c} ±.32	17.53^{d} ±.34	36.70^{d} ±.41
V1 NPK	15.43^{c} ±.27	25.30^{c} ±.61	46.50^{c} ±.60
V1 OF	19.03^{b} ±.51	31.46^{b} ±.42	56.03^{b} ±.40
V1 NPK+OF	23.13^{a} ±.18	33.83^{b} ±1.01	62.56^{a} ±.54
V2 Control	12.60^{d} ±.45	24.30^{d} ±.10	43.96^{d} ±.43
V2 NPK	14.80^{c} ±.37	33.46^{c} ±.46	69.76^{c} ±.42
V2 OF	17.66^{b} ±.23	36.53^{b} ±.37	79.13^{b} ±.41
V2 NPK+OF	24.13^{a} ±.33	43.16^{a} ±.17	87.86^{a} ±.65
V3 Control	13.10^{d} ±.60	23.56^{d} ±.29	37.40^{d} ±.49
V3 NPK	16.16^{c} ±.48	31.23^{c} ±.54	60.56^{c} ±.53
V3 OF	18.16^{b} ±.54	33.60^{b} ±1.08	62.43^{b} ±.29
V3 NPK+OF	22.13^{a} ±.14	38.13^{a} ±.29	74.53^{a} ±.57
V4 Control	13.16^{d} ±.06	22.56^{d} ±.29	44.66^{d} ±.29
V4 NPK	15.50^{c} ±.30	31.13^{c} ±.39	56.16^{c} ±.28
V4 OF	19.53^{b} ±.28	36.86^{b} ±.37	63.76^{b} ±.17
V4 NPK+OF	22.83^{a} ±.17	41.43^{a} ±.726	78.13^{a} ±.29

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

Plant height was drastically affected by the treatment having combination of both NPK and organic matter. Application of 50% NPK and 50% organic matter combination significantly increased plant height in wheat as shown in table 1. First plant height was recorded after 45, 60 and then plant height was recorded after 90 days of sowing. Significant increase in plant height was recorded in all four treatments applied to wheat but difference among the varieties was non-significant. Maximum plant height (87.86cm) was recorded in NPK and organic matter combination treatment in variety HD3086 while the minimum plant height (12.60cm) recorded in HD3086 with no NPK and organic matter. Maximum increment of 73.51% in HD 3086 by the application of both 50% NPK and 50% organic fertilizer from 45 days of sowing to 90 days of sowing.

The plant height was observed at different days. Firstly, it was recorded at 45 days of sowing. The height was increased in all the varieties treated with the combination of both NPK and organic fertilizer. There was significant increase in height having the maximum height of 24.13cm in application of both NPK and organic fertilizer (50% + 50%) and minimum height of 12.60 cm was observed with no NPK and organic fertilizer. There was 28.08% increment in the height than the minimum height.

The plant height was recorded at 60 days after sowing. There was bit increase in plant height as last observed at 45 days of sowing. All four varieties with different treatments show variable results by increasing the height. The treatment having the application of both of combination of NPK and organic fertilizer shows the significant results. In variety HD3086, maximum height of the plant was observed as 43.16cm in the treatment of combination of 50% NPK and 50% organic fertilizer and minimum height of the plant was observed in variety PBW725 as 17.53cm with control treatment having no NPK and organic fertilizer.

The last observation of plant height was taken at 90 days after sowing. There was tremendous increase in the plant height of variety HD3086 by the application of the both 50% NPK and 50% or4ganic fertilizer. The maximum increase in the plant height was under the treatment of combination of NPK and organic fertilizer. The maximum height attained by plant at 90 days after sowing was 87.86cm under the treatment of both 50%NPK and 50% organic fertilizer in HD3086 and least increase under no NPK and organic fertilizer as 36.70 cm in PBW725

The NPK was used as the chemical fertilizer and the organic fertilizer was FYM. Under organic fertilizer treatment, there should be poultry manure as well. The organic fertilizer used long with the chemical fertilizer increases the availability of the nutrients and improves the physical, chemical and biological properties of the soil. Height wise, variety HD3086 was better than PBW725, HD2967 and PBW677. The treatment having no NPK and organic fertilizer shows least results followed by only 100% NPK and only 100% organic fertilizer. The application of combination of both 50% NPK and 50% organic fertilizer gave the superior results of the plant height. The application of combination of both NPK and organic fertilizer increases the concentration of nutrients in soil. The application of FYM along with urine was also very effective if used along with the chemical fertilizers. The finest combination of fertilizers and manures which comprised of poultry manure blended with inorganic fertilizers (IPNS origin at BAU farm). Application of poultry manure along with inorganic fertilizer significantly increased the height of the plant (Reddy *et al*., 2010). The height of the plant increased significantly whean FYM was applied 5t/ha along with 100% NPK (Yogananda *et al.,* 2011.

B. Number of Leaves

Application of combination of both NPK and organic fertilizer greatly affect the number of leaves. The number of leaves was drastically increased by the application of both NPK and organic fertilizer. Three data were recorded at specific days. The number of leaves was recorded at 45, 60 and 90 days after sowing. First data was recorded at 45 days after sowing, second data was recorded at 60 days after sowing and third data was recorded at 90 days after sowing. The application of both NPK (50%) and organic fertilizer (50%) increase the number of leaves per plant at large scale as shown in table 2.

First observation was taken at the 45 days after sowing. The number of leaves was counted per plant. Few plants had very good number of leaves. All the four varieties showed their result at 45 days after sowing. But the varieties under the treatment of combination of both NPK and organic fertilizer showed the significant increase in the number of leaves per plant. The maximum number of leaves was 16 in the fourth treatment of combination of both NPK and organic fertilizer (50% + 50%) as shown in table 2 and the minimum number of leaves was 8

in the control treatment where zero NPK and organic fertilizer was applied. The maximum number of leaves comes from variety HD2967 and the lowest number of leaves comes from control under variety PBW 725.

Table 2
Effects of NPK and organic fertilizer on the number of leaves plant^{-1} in wheat

Treatment	45DAS	60DAS	90DAS
V1 Control	8.00^{c} ±.57	17.33^{d} ±.33	24.00^{d} ±.57
V1 NPK	9.00^{bc} ±.00	19.66^{c} ±.33	30.66^{c} ±.66
V1 OF	9.66^{b} ±.33	22.66^{b} ±.88	50.00^{b} ±.57
V1 NPK+OF	14.00^{a} ±.57	34.00^{a} ±.57	76.33^{a} ±.33
V2 Control	9.66^{c} ±.33	31.66^{d} ±.66	30.33^{d} ±.33
V2 NPK	11.66^{b} ±.33	39.00^{c} ±.57	42.00^{c} ±.00
V2 OF	12.33^{b} ±.33	43.66^{b} ±.33	64.66^{b} ±.33
V2 NPK+OF	14.00^{a} ±.57	49.33^{a} ±.33	88.00^{a} ±.57
V3 Control	8.66^{c} ±.33	26.33^{d} ±.33	35.00^{d} ±1.15
V3 NPK	10.00^{c} ±.57	31.33^{c} ±.66	40.66^{c} ±.33
V3 OF	12.33^{b} ±.33	39.00^{b} ±.57	52.33^{b} ±.88
V3 NPK+OF	16.00^{a} ±.57	51.66^{a} ±.33	85.66^{a} ±.33
V4 Control	10.33^{c} ±.33	23.66^{d} ±.88	22.33^{c} ±.66
V4 NPK	12.33^{b} ±.33	30.33^{c} ±.88	36.83^{bc} ±.71
V4 OF	12.66^{b} ±.33	38.33^{b} ±.33	47.66^{b} ±1.03
V4 NPK+OF	15.66^{a} ±.33	52.00^{a} ±.57	77.00^{a} ±.57

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

Second data was recorded at 60 days after sowing. Significant increase in the number of leaves per plant as last reading was noted at 45 days after sowing during the growth stages of the plant. The treatment having the application of both the fertilizer in equal proportion shows the better result in all the varieties rather than the other treatments having 100% NPK and 100% organic fertilizer. The maximum number of leaves per plant of variety PBW677 was 52 and the minimum number of leaves of variety PBW725 was 17. The minimum number of leaves comes in control treatment which was having zero application of fertilizer.

Last observation was taken at the 90 days after sowing. Very little increase in the number of leaves as the last reading was taken at 60 days of sowing. Plant completes its growth stage and maximum number of leaves was attained at this period of time. Usually, like the previous data the forth treatment of the application of combination of both NPK and organic fertilizer was best. It gave the maximum number of leaves per plant. The maximum number of leaves of variety HD3086 was 88 and the minimum number of leaves of variety PBW677 was 22, as maximum by the application of the both NPK and organic fertilizer and minimum by the control treatment having no NPK and organic fertilizer.

The maximum number of leaves comes by application of both 50% NPK and 50% organic fertilizer. The organic and inorganic fertilizer provides nutrient to the soil that stimulates the plant growth and development. Alone NPK or organic fertilizer could not give the results up to this extent. The results from only 100% NPK and 100% organic fertilizer were also appreciable but tremendous results by applying both in combination in equal proportion. The results were superior in long term use of applying both treatment (Khan et al., 2003). In earlier study, due to slowly release of organic fertilizer and combination with inorganic fertilizer the number of leaves significantly increased (B. W. Green., 2015).

C. Number of Tillers

The number of tillers was significantly increased by the application of both NPK and organic fertilizer. The observations were taken at two distinct growth stages. First reading of the number of tillers was taken at 45 days of sowing and second reading was taken at 60 days of sowing. The number of tiller increases by the application of the combination of both NPK and organic fertilizer in equal proportion as shown table 3. The maximum number of tillers was 10 and minimum number of tillers was 1. The maximum number of tiller comes by the application of 50% NPK and 50% organic fertilizer and minimum number of tiller was 1 in the zero application of NPK and organic fertilizers.

The first reading was taken at 45 days of sowing. There was very less difference in the counting of the tillers in each treatment and variety. The results from the application of 100% NPK and 100% organic fertilizer were almost same as the increase in number of tillers were same. The only difference was the control treatment. The control treatment was having nothing any application of NPK and organic fertilizer. The maximum number of tillers comes from the treatment having both 50% NPK and 50% organic fertilizer.

Second observation was taken at 60 days of sowing. The forth treatment with the application of both NPK and organic fertilizer gave the best results in all the varieties. The maximum number of tillers attained by the plant under the application of both 50% NPK and 50% organic fertilizer. The minimum number of tillers was recorded in the first treatment of each variety with no NPK and organic fertilizer. The second and third treatment of each variety shows the same results. The application of 100% NPK and 100% organic fertilizer also shows the best results. But the forth treatment was better than all.

Table 3
Effects of NPK and organic fertilizer on the number in tillers plant^{-1} of wheat

Treatment	45DAS	60DAS
V1 Control	1.66^{b} ±.33	3.66^{c} ±.33
V1 NPK	2.66^{ab} ±.33	5.00^{b} ±.57
V1 OF	3.00^{ab} ±.57	5.66^{ab} ±.33
V1 NPK+OF	4.00^{a} ±.57	6.66^{a} ±.33
V2 Control	1.33^{c} ±.33	3.66^{c} ±.33
V2 NPK	2.66^{b} ±.33	5.66^{b} ±.66
V2 OF	3.00^{b} ±.00	6.33^{b} ±.33
V2 NPK+OF	5.00^{a} ±.57	10.33^{a} ±.33
V3 Control	1.66^{b} ±.33	4.00^{a} ±1.15
V3 NPK	3.66^{a} ±.33	3.33^{a} ±.33
V3 OF	3.33^{a} ±.33	6.33^{a} ±1.20
V3 NPK+OF	4.33^{a} ±.33	7.33^{a} ±1.20
V4 Control	2.00^{c} ±.00	5.00^{c} ±.00
V4 NPK	3.33^{b} ±.33	6.33^{b} ±.33
V4 OF	3.33^{b} ±.33	7.00^{b} ±.57
V4 NPK+OF	4.33^{a} ±.33	8.33^{a} ±.33

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

From the above table, it was clear that the forth treatment

with the application of both 50% NPK and 50% organic fertilizer gave the best results. The variety HD3086 has the maximum number of tillers of 10 under the treatment of both 50% NPK and 50% organic fertilizer. Two varieties, PBW725 and HD3086 showed the least number of tillers under control treatment having no NPK and organic fertilizer. It was found that application of urea-N and manures, 6% increase the number of tillers (Yakub *et al*., 2010). This treatment provides better chance to crop for better growth especially in vegetative growth stage (Chhogyel *et al*., 2015).

D. Grain Weight

The grain weight was increased by the application of both NPK and organic fertilizer. The weight of the grain decides the yield of the crop. All the varieties showed their best results in the treatment of application of both 50% NPK and 50% organic fertilizer rather than by the application of 100% NPK, 100% organic fertilizer and no NPK and organic fertilizer. As per the varieties, the variety HD3086 was best having the maximum grain weight as compare to other varieties PBW725, HD2967 and PBW677.

Table 4
Effects of NPK and organic fertilizer on the grain weight (g) in wheat

Treatment	Grain wt. (g)
V1 Control	4.88^{c} ±.86
V1 NPK	7.99^{b} ±.51
V1 OF	9.97^{b} ±.86
V1 NPK+OF	20.64^{a} ±.56
V2 Control	8.69^{d} ±.20
V2 NPK	11.37^{c} ±.66
V2 OF	13.87^{b} ±.19
V2 NPK+OF	24.07^{a} ±.49
V3 Control	9.76^{c} ±.67
V3 NPK	11.98^{bc} ±.83
V3 OF	13.42^{b} ±.56
V3 NPK+OF	18.79^{a} ±.49
V4 Control	8.38^{d} ±.30
V4 NPK	12.48^{c} ±.68
V4 OF	15.62^{b} ±.38
V4 NPK+OF	22.07^{a} ±.33

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

The table shows the grain weight of various varieties under the different treatments. Application of both fertilizers in combination significantly increased the grain weight. Each variety which was treated with combination of both 50% NPK and 50% organic fertilizer showed increase in the grain weight, as maximum grain weight attained by the variety HD3086 as compare to other varieties PBW725, HD2967and PBW677. The grain weight was highly affected by the application of both NPK and organic fertilizer in combination as compare to other treatments of 100% NPK and 100% organic fertilizer.

The wheat grain yield was diversely significant because of the combined use of poultry manures, compost, cow dung and NPKS fertilizers. The varieties treated with poultry manure gave maximum grain with same recommended fertilizer doses as fertilizers and manures influence wheat grain yield as compare to cow dung and treated plots of compost. The nutrients were discharged hastily by the occurrence of uric acids in poultry manure rather than cow dung and compost. It was found that application of urea-N and manures, 6% increase of grain yield (Yakub *et al*., 2010). Also, initiate increased yield of grain with the combined application of fertilizers and manures (Haque *et al*., 2001, Asit *et al*., 2007) and (Bodruzzaman *et al*., 2010).

E. Straw Weight

The straw weight of the wheat significantly increased by the application of both 50% NPK and 50% organic fertilizer in combination. The varieties having the treatment with both NPK and organic fertilizer showed the highest results having the maximum straw weight. Straw weight decreases with the application of only 100% NPK and 100% organic fertilizer and least results were noted in the control treatment having zero or no NPK and organic fertilizer.

Table 5
Effects of NPK and organic fertilizer on the straw weight (g) in wheat

Treatment	Straw wt. (g)
V1 Control	6.34^{d} ±.38
V1 NPK	12.19^{c} ±.38
V1 OF	21.37^{b} ±.70
V1 NPK+OF	25.77^{a} ±.41
V2 Control	13.01^{d} ±.54
V2 NPK	22.40^{c} ±.76
V2 OF	28.05^{b} ±.65
V2 NPK+OF	48.04^{a} ±.43
V3 Control	14.11^{d} ±.41
V3 NPK	23.94^{c} ±.55
V3 OF	28.21^{b} ±.30
V3 NPK+OF	36.14^{a} ±.51
V4 Control	8.39^{d} ±.22
V4 NPK	21.36^{c} ±.48
V4 OF	27.89^{b} ±.46
V4 NPK+OF	32.73^{a} ±.56

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

It was clear from the above table that the control treatment having no NPK and organic fertilizer has least straw weight and the treatment having the combination of both 50% NPK and 50% organic fertilizer showed increase in the straw weight in each variety. The variety HD3086 showed maximum straw weight as compare to other varieties PBW725, HD 2967 and PBW677.

F. Fe Content in Grain

After harvesting the crop, the iron content was observed from the grains of the wheat. Grains rich in iron content were estimated. As usual, the varieties with treatment 50% NPK and 50% organic fertilizer showed the higher iron content. The other treatments which were treated with only 100% NPK and only 100% organic fertilizer and no NPK and organic fertilizer showed the least results. The good quality grains were highly nutritious having more content of iron.

From the table 6, it was clear that the treatment having the application of both NPK and organic fertilizer showed the highest outcome of iron content. The application of both NPK

and organic fertilizer increased the nutrient uptake by the plant and hence, increased the quality and quantity of the grain.

By the collective use of fertilizers and manures the yield of wheat straw also responded significantly. It was also observed the yield of wheat straw increased by collective appliance of organic manure with fertilizers, considerably (Akhtar *et al*., 2011). Application of 100% NPK showed not best results as compare to 50% NPK and 50% organic matter to increase the straw weight (Kumar and Yadav., 1995). This could be stable by using this treatment (Tiwari *et al.,* 1980).

Table 6
Effects of NPK and organic fertilizer on the Fe content (ppm) in wheat grain

Treatment	Fe Content
V1 Control	33.49^{d} ±.02
V1 NPK	45.04^{c} ±0.2
V1 OF	79.13^{b} ±.31
V1 NPK+OF	83.51^{a} ±.60
V2 Control	40.24^{d} ±.02
V2 NPK	47.66^{c} ±.31
V2 OF	79.08^{b} ±.31
V2 NPK+OF	100.81^{a} ±.89
V3 Control	23.24^{d} ±.14
V3 NPK	44.49^{c} ±.14
V3 OF	77.65^{b} ±.14
V3 NPK+OF	83.79^{a} ±.14
V4 Control	43.02^{d} ±.37
V4 NPK	48.01^{c} ±.09
V4 OF	72.02^{b} ±.22
V4 NPK+OF	98.31^{a} ±.60

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at p<0.05 for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer.

G. Protein Content in Grain

Table 7
Effects of NPK and organic fertilizer on the protein content (%) in wheat grain

Treatment	Protein Content (%)
V1 Control	7.49^{d} ±.02
V1 NPK	8.04^{c} ±.04
V1 OF	10.13^{b} ±.31
V1 NPK+OF	11.51^{a} ±.60
V2 Control	8.24^{d} ±.04
V2 NPK	9.66^{c} ±.31
V2 OF	9.08^{b} ±.31
V2 NPK+OF	12.81^{a} ±.89
V3 Control	6.24^{d} ±.02
V3 NPK	8.49^{c} ±.04
V3 OF	10.65^{b} ±.33
V3 NPK+OF	11.52^{a} ±.62
V4 Control	8.02^{d} ±.04
V4 NPK	10.01^{c} ±.29
V4 OF	9.02^{b} ±.22
V4 NPK+OF	11.31^{a} ±.60

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at p<0.05 for separation of means).

Note: There was 4 treatments like T1 (control), T2 (NPK), T3 (Organic fertilizer) and T4 (NPK + Organic fertilizer).

The protein content increased by the application of both 50% NPK and 50% organic fertilizer in combination. The NPK and organic fertilizer provides nutrients to the soil and stimulates the growth and development of the plant. The percent protein increased by the application of both NPK and organic fertilizer in equal proportion. Protein content was estimated after harvesting the crop from the grains.

From the above table, the results were that the application of both 50% NPK and 50% organic fertilizer was highly affective. The maximum protein content was observed under the variety HD3086 and the minimum protein content under the variety HD2967. As the other treatments was also showed their best results. The treatment with only100% NPK and only 100% organic fertilizer showed better protein content.

From the above table it was clear that that the second HD3086 and forth variety PBW677under the treatment of combination of both 50% NPK and 50% organic fertilizer showed the highest results. The grains of above varieties were highly nutritious having the enough Fe content. On the other hand, remaining varieties HD2967 and PBW725 also showed better results by the same treatment but least results by the application of both NPK and organic fertilizer. The highest content of iron was notes in variety HD3086 under the treatment of both NPK and organic fertilizer as 100 and the lowest content was 23 of variety HD2967 under the control treatment having no NPK and organic fertilizer. The percent increment from the maximum and minimum content was 77%. The application of vermicompost along with the chemical fertilizer highly influenced the iron content (Densilin*et al*., 2010). Application of N in excess amount was major reason in poor absorption of micronutrients (Singh *et al*.,1992). Micronutrient content was poor in grain from control and 100% chemical fertilizer application (Bhandari *et al*., 1992).

3. Conclusion

The pot experiment was examined at the lovely professional university, phagwara. The pots were kept at university farm field to study about soil characteristic features and availability of nutrients under various fertilization strategies of wheat. Four varieties were examined named as PBW725, HD3086, HD2967 and PBW677 under sixteen treatments having control (no NPK and organic fertilizer), 100% NPK, 100% organic fertilizer and NPK + organic fertilizer (50% + 50 %). The height and number of leaves were recorded at 45, 60 and 90 days after sowing whereas tillers were recorded at 45 and 60 days after sowing. Yield parameters were also recorded after the harvest. Treatment with the application of both 50% NPK and 50% organic fertilizers were most dominant and effective that drastically increased the height, number of leaves, and number of tillers, grain weight, straw weight, Fe content and protein content.

Plant height of wheat was significantly increased by the application of both NPK and organic fertilizer in equal proportion in soil. Maximum plant height (87.86cm) was recorded in NPK and organic matter combination treatment in variety HD3086 while the minimum plant height (12.60cm) recorded in HD3086 with no NPK and organic matter. Application of combination of both NPK and organic fertilizer greatly affect the number of leaves. The number of leaves was significantly increased by the application of both NPK and organic fertilizer. Maximum number of leaves (88) in variety HD3086 under the treatment 50% NPK and 50% organic

fertilizer while minimum number of leaves (8) in variety PBW725 under control treatment having zero NPK and organic fertilizer.

Number of tillers was also increased by the treatment of 50% NPK and 50%organic fertilizer. The maximum number of tillers (10) in variety HD3066 and minimum number of tillers (1) in varieties PBW725 and HD3086 was recorded. The maximum number of tiller comes by the application of 50% NPK and 50% organic fertilizer and minimum number of tiller under zero application of NPK and organic fertilizer.

The grain weight was significantly increased by T2 (100% NPK), T3 (100% organic fertilizer), T4 (50% NPK and 50% organic fertilizer). As the performance of T2 and T3 was better but the best treatment was the application of both the fertilizer in equal quantity (T4). As per the varieties, the variety HD3086 was best having the maximum grain weight as compare to other varieties PBW725, HD2967 and PBW677. The maximum grain (24gm) was recorded under the application of 50% NPK and 50 % organic fertilizer of variety HD3086 and minimum grain weight (4gm) was recorded under T1, control treatment having no NPK and organic fertilizer in variety PBW725.

The straw weight was also examined in all the treatments. The straw weight of the wheat significantly increased by the application of both 50% NPK and 50% organic fertilizer in combination. The varieties having the treatment with both NPK and organic fertilizer showed the highest results having the maximum straw weight. Straw weight decreases with the application of only 100% NPK and 100% organic fertilizer but performed well and least results were noted in the control treatment having zero or no NPK and organic fertilizer. The maximum straw weight (48gm) in variety HD3086 with the application of both 50% NPK and 50% organic fertilizer and minimum straw weight (6gm) in variety PBW725 with control treatment was observed.

After harvesting the crop, the iron content was observed from the grains of the wheat. Grains rich in iron content were estimated. As usual, the varieties with treatment 50% NPK and 50% organic fertilizer showed the higher iron content. The other treatments which were treated with only 100% NPK and only 100% organic fertilizer and no NPK and organic fertilizer showed the least results. The good quality grains were highly nutritious having more content of iron. The application of both NPK and organic fertilizer increased the nutrient uptake by the plant and hence, increased the quality and quantity of the grain. The highest content of iron was noted in variety HD3086 under the treatment of both NPK and organic fertilizer as 100 and the lowest content was 23 of variety HD2967 under the control treatment having no NPK and organic fertilizer.

The NPK and organic fertilizer provide nutrients to the soil and stimulate the growth and development of the plant. The percent protein increased by the application of both NPK and organic fertilizer in equal proportion. Protein content was estimated after harvesting the crop from the grains. it was observed that the treatment with application of both 50% NPK and 50% organic fertilizer in combination showed the highest content of protein. On the other hand, the other treatments also showed good results. The treatment having only 100% NPK and 100% organic fertilizer also increased the protein content. The protein content was highest in variety HD3086 as 13% under the application of both 50% NPK and 50% organic fertilizer and the minimum protein content was noted under HD2967 as 6% under no treatment of zero NPK and organic fertilizer.

It was concluded from research that the application of both the fertilizers in equal proportion (50% NPK and 50% organic fertilizer) could give better yield and quality of grain as compare to 100% NPK and 100% organic fertilizer. The variety HD3086 was identified as best amongst all.

By looking at the conclusion, present and future scenario regarding the depletion of soil by using the heavy fertilizers, deficiency of micronutrients in soil and fewer yields of wheat further studies should be carried out with deep concern. The various varieties should be screened out so that the best variety can be identified with best characters of up taking micronutrients. The best treatments should also be identified. Vermicompost and poultry farm manures should be tested in term of helping in uptake of various micronutrients.

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