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CONTENTS

Integrated effect of natural farming concoctions and organic farming practices with various NPK doses on quality of bread wheat

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ABSTRACT: The field experiment was carried out during the *Rabi* 2021-22 and 2022-23 at experimental block, School of Agricultural Sciences, Shri Guru Ram Rai University (SAS-SGRRU), Pathribagh, Dehradun, Uttarakhand to study the effect of various nutrient management approaches on NPK content, NPK uptake and protein content in wheat. The experiment was laid out in split plot design with three organic nutrient management treatments in main plots *i.e.*, organic farming practices (vermicompost @ 5 t ha^{-1} + seed inoculation with *Azotobacter* and PSB + 2 sprays of vermiwash at 30 & 45 DAS); Natural farming practices (sieved cow dung @ 2.5 t ha^{-1} + seed treatment with *Bijamrit* + *Jeevamrit* @ 200 l ha^{-1}); and absolute control. The sub-plots comprised 100% recommended dose of fertilizers (RDF), 75% RDF, 50% RDF and 25% RDF. The experiment had three replications. The results revealed that the integration of organic farming practices, natural farming practices and different doses of NPK fertilizers influenced all the quality parameters in wheat grain during both the years. Organic farming practices exhibited 15% and 12% increment in protein content during 2021-22 and 2022-23, respectively, compared to the absolute control; and 12% and 8% increase over natural farming practices. However, 75% RDF secured 10% and 7% more protein over 100 % RDF, 13% and 11% over 50% RDF and 19% and 10% over 25% RDF during both the consecutive years, respectively. Furthermore, NPK content and uptake by grains and straw were found to be higher in organic farming practices and 75% RDF as compared to other treatments. Thus, adoption of organic farming practices coupled with application of 75% NPK is recommended for enhancing protein, nitrogen, phosphorus and potash content, thereby sustaining nutritional quality of wheat in the western Himalayan zones of Uttarakhand.

Key words: Natural farming, NPK content, NPK uptake, organic farming, protein, wheat

The most significant staple food crop in the world, wheat (*Triticum aestivum* L.), is now recognized as the foundation of India's food security. Because of its greater nutritional content and wider range of adaptability, it is cultivated all over the world. With an area of 30.79 million hectares, wheat is the second most significant cereal crop after rice. Its productivity per hectare is 3533 kg, and its total yearly production is 103.6 million tons (Kantwa *et al.*, 2023). Due to their demanding character, dwarf wheat cultivars, while full of potential, have become a serious danger to the long-term sustainability of grain production. The primary threat to Indian agriculture is the application of chemical fertilizers, which have a detrimental effect on soil health and lead to unsustainable yields (Eid *et al.*, 2006). This problem is made worse by the ongoing, excessive use of fertilizers in soils with low organic matter content (Singh and Pal, 2011). To maximize productivity while reducing environmental contamination, the nutrient supply, fluxes, and additional nutrient should all be carefully regulated (Finck, 1998).

Therefore, optimizing crop nutrition through the organic farming and natural farming and integrating with synthetic fertilizers in rational way is essential for long-term agricultural sustainability. Due to declining soil health and fertility as well as decreased factor production, these approaches are becoming more and more important. These entail the concurrent use of chemical fertilizers, organic manures, bio-fertilizers, etc. (Prasad *et al.*, 2010). In the current situation, integrated strategies are thought to be a workable way to improve soil fertility and yields while ensuring longer-term improvement in nutritional status of the crop. When combined with mineral nutrients, organic manures not only raise production levels but also enhance soil health by positively affecting the soil's biological, chemical, and physical characteristics. This helps to maintain

productivity (Lourduraj, 1999; Negi *et al.*, 2023; Rawat *et al.*, 2023; Kumari and Verma, 2023; Juyal *et al.*, 2023; Rana and Verma 2021).

Utilizing organic and natural source of nutrients helps prevent nutrient deficiencies which are a major contributing cause to crops responding less favorably to NPK supplied solely through fertilizers and provides essential, secondary, and micronutrients. Additionally, there is a noticeable long-term impact of organic manures like farm yard manures, vermicompost, vermiwash etc. on soil fertility (Babhulkar *et al.*, 2000). On the other hand, the primary source of microbial inoculants, which have raised expectations for many nations' economies and environments, is biofertilizers. Biofertilizers help alleviate the issue of increased fertilizer costs in developing nations such as India, thus saving the national economy (Gupta *et al.*, 2003). Because biofertilizers are not only affordable but also environmentally benign, biofertilization is gaining more and more attention and recognition (Mahdi, 1993).

Therefore, the present investigation was carried out to study the effect of natural farming, organic farming and different NPK doses on nutrient content, uptake and protein content. We hypothesized that these practices would improve nutrient uptake in crop and protein content.

MATERIALS AND METHODS

The Experiment block of the School of Agricultural Sciences, Shri Guru Ram Rai University (SAS-SGRRU), Pathribagh Dehradun, Uttarakhand, is located in the northwest of the state at an elevation of 450 meters above mean sea level (MSL) and between 29°58' and 31°2'30' North latitude and 77°34'45'' and 78°18'30'' East longitude. The field experiment was carried out during *Rabi* 2021–22 and 2022–23. The average weekly maximum temperature during 2021-22 and 2022-23 varied between 15.2 ºC to 37.8 ºC and 16.8 ºC to 30.2 ºC, respectively. However, average minimum temperatures were 2.2 ºC to 14.5 ºC and 7.7 ºC to 18.5 ºC, respectively. The experiment was laid out in split plot design with three organic nutrient management treatments in main plots *i.e.*, organic farming practices (vermicompost @ 5 t ha^{-1} + seed inoculation with *Azotobacter* and PSB + 2 sprays of vermiwash at 30 & 45 DAS); Natural farming practices (sieved cow dung @ 2.5 t ha^{-1} + seed treatment with *Bijamrit* + *Jeevamrit* @ 200 l ha^{-1}); and absolute control. The sub-plots comprised 100% RDF, 75% RDF, 50% RDF and 25% RDF. The experiment had three replications. The experimental field was ploughed, and then it was adequately prepared with the help of a tractor-drawn leveller. Two cross-wise harrowing were then conducted on the land at the optimal soil moisture state. The wheat variety DBW 173 was sown using the line sowing method on November 14 and 16, 2021 and 2022, respectively. The seed rate was 100 kg ha^{-1}, and the row-to-row spacing was 22.5 cm. During field preparation, vermicompost, sieved cow dung, *Jeevamrit*, and different doses of RDF (120: 60: 40 kg NPK ha^{-1}) were added and well mixed into the soil according to the treatments listed in the various blocks. Vermiwash was sprayed at 30–40 DAS, and the seeds were treated with *Azotobacter*, PSB, and *Bijamrit* 24 hours prior to planting. The initial irrigation was given in both years during the crown root initiation (CRI) stage, which occurs normally 21–25 days following seeding. The timing of subsequent irrigations was determined by the moisture level of the soil. The crop was manually harvested with a sickle after the grain hardened and reached a moisture level of 18–20%. The collected material was then sun-dried for three to four days in order to separate the grain from the straw.

Protein content in the wheat grain during both the years of experimentation was enumerated by using Kjeldahl method involving the digestion of the grinded wheat grain with a strong acid to release the nitrogen, which was then quantified using a titration technique. Protein quantity was then calculated from the nitrogen concentration of the wheat grinded grain using a conversion factor (usually 6.25 which is equivalent to 0.16 g nitrogen per gram of protein) (Biancarosa *et al.*, 2017).

For the estimation of total nitrogen, phosphorous

and potassium content (%) in the wheat crop (grain and straw), grounded samples were passed through a 2 mm mesh size sieve as per the treatment and 0.2 g of this sample was subjected to chemical analysis. The plant samples were digested with concentrated sulphuric acid containing salicylic acid (1 g salicylic acid in 30 ml of concentrated H_2SO_4) for estimation of % nitrogen in plant sample. However, for the estimation of % phosphorous & % potassium, plant samples were oxidized with tri-acid mixture of concentrated HNO_3 (70%), H_2SO_4 (98%) and perchloric acid (70%) in 9:4:1 ratio. The NPK uptake kg ha^{-1} was calculated by multiplying the concentration of N, P & K in grain and straw with the grain and straw yield kg per hectare, respectively, divided by 100 and multiplied by suitable moisture correction factor.

$$\text{N, P or K uptake(kg ha}^{-1}\text{)} = \frac{\text{\% N, P or K x dry matter accumulation kg ha-1 by gain and straw}}{100} \times \text{MCF}$$

Where MCF= moisture correction factor

RESULTS AND DISCUSSION

Organic farming practices, natural farming practices and application of different rates of NPK significantly influenced the grain protein (%) during both the years of experimentation. Significantly higher crude protein content (%) was recorded with the incorporation of organic farming practices (Vermicompost @ 5 t ha^{-1} + seed inoculation with *Azatobacter* and PSB + 2 sprays of Vermiwash at 30 & 45 DAS) followed by Natural farming practices (Sieved cow dung @ 2.5 t ha^{-1} + seed treatment with *Bijamrit* + *Jeevamrit* @ 200 l ha^{-1}). The significantly lower protein content was recorded in absolute control where no organic manures were applied (Table 1). The slow release of nutrients from vermicompost & vermiwash over the growing season is likely the cause of the rise in grain nitrogen and protein content. Additionally, compared to natural farming practices, wheat fertilized with organic farming composts had greater grain protein content, according to Abedi *et al.* (2010). Because of the slow release of plant nutrients from this, intense rains and anoxic soil conditions do not significantly leach or gaseously lose nitrogen throughout the growth season. Again, addition of vermicompost, PSB & Vermiwash might have enhanced nutrient pool and nitrogen might have mineralized the organic matter whereby ample amount of nitrogen was extracted by the plant following its assimilation into amino acids and protein.

Additionally, substantially greater protein content was recorded with 75% RDF across the different NPK dosages, followed by 100%, 50%, and 25%. The observed increased in protein content could potentially be attributed to elevated levels of N, P, and K in the soil, which could stimulate greater root activity and enhance plant uptake and assimilation of nitrogen. Additionally, it may facilitate the transfer of nitrogen from vegetation to grains, potentially impacting protein concentration indirectly. The outcomes concur with findings of Mishra *et al.* (2008) and Chandal *et al.* (2014).

The NPK contents and their uptake by grain and straw in both years were also greatly impacted by the use of natural and organic agricultural techniques (Table 2). When compared to natural agricultural techniques, this was markedly boosted in areas where organic farming practices were implemented. The fact that many of the nutrients in vermicompost are transformed into forms that are easier for plants to absorb is one of its key qualities. In a research, Moreau *et al.* (2019) found that adding nitrate or ammonium nitrogen enhanced the quantity of nitrogen in the soil and the plants.

Vermicompost and vermiwash, when added to the soil, increase the number of beneficial microorganisms such as N-fixers and enhance the activity of urease and nitrogenous enzymes. This results in a more efficient and productive plant metabolism, which raises the nitrogen content of the plant tissue (Gopalreddy, 1997). Plants treated with organic manure had greater N, P, and K levels than control plants (Amanullah *et al.*, 2007). Additionally, studies have demonstrated that the application of organic manure typically improves crop nutrient content and absorption since the amount of organic manure in the soil influences nutrient availability as

Table 1: Effect of natural farming concortions, organic farming practices and various NPK rates on grain protein content and NPK contents in grain & straw of wheat during 2021-22 and 2022-23

Treatment	Nitrogen content (%)				Phosphorus content (%)				Potassium content (%)				Protein content (%)	
	Grain		Straw		Grain		Straw		Grain		Straw		Grain	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Organic/Natural farming practices														
Absolute control	2.11	1.41	0.96	0.95	0.21	0.25	0.142	0.153	0.71	0.75	1.19	1.31	10.65	11.54
Organic farming practices	2.42	1.68	1.12	1.19	0.25	0.29	0.159	0.166	0.76	0.86	1.27	1.41	12.54	13.24
Natural farming practices	2.36	1.46	1.08	1.09	0.23	0.28	0.151	0.158	0.74	0.81	1.22	1.35	10.98	12.24
C.D. (P= 0.05)	0.030	0.080	0.030	0.080	0.010	0.010	0.002	0.010	0.030	0.020	0.030	0.020	0.647	0.741
Fertilizer doses														
100% RDF	2.23	1.31	0.99	1.02	0.23	0.25	0.145	0.151	0.75	0.81	1.28	1.30	11.32	12.54
75% RDF	2.36	1.49	1.17	1.34	0.28	0.31	0.147	0.158	0.78	0.89	1.30	1.33	12.65	13.57
50% RDF	2.30	1.48	0.95	1.11	0.26	0.24	0.134	0.144	0.72	0.78	1.24	1.23	10.98	12.05
25% RDF	2.40	1.36	0.84	1.09	0.28	0.21	0.133	0.14	0.65	0.75	1.21	1.22	10.21	12.17
C.D. (P= 0.05)	0.030	0.028	0.030	0.011	0.010	0.014	0.001	0.012	0.010	0.004	0.010	0.040	0.910	0.961

Table 2: Effect of Natural farming concortions, organic farming practices and various NPK rates on NPK uptake by grain & straw of wheat during 2021-22 and 2022-23

Treatment	Nitrogen uptake (kg ha^{-1})				Phosphorus uptake (kg ha^{-1})				Potassium uptake (kg ha^{-1})			
	Grain		StrawGrain		Straw		Grain		Straw			
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Organic/Natural farming practices												
Absolute control	111.21	115.64	55.12	60.14	10.23	12.34	9.15	10.11	23.32	24.59	75.14	78.94
Organic farming practices	116.51	118.95	65.17	66.74	15.14	16.41	11.23	12.54	27.54	27.89	95.65	92.25
Natural farming practices	113.24	115.65	62.84	65.12	13.27	13.52	10.14	10.54	24.12	25.24	84.56	85.64
C.D. (P= 0.05)	1.121	1.117	1.514	1.247	0.800	0.995	0.541	0.472	1.12	1.114	4.541	5.142
Fertilizer doses												
100% RDF	110.23	116.52	64.56	68.57	14.23	15.21	10.01	11.24	31.24	32.14	84.56	87.24
75% RDF	115.64	138.54	65.21	68.98	15.14	16.99	10.14	11.57	34.51	36.51	89.67	88.24
50% RDF	112.14	112.56	62.23	68.23	10.27	13.14	9.65	10.27	26.54	27.54	74.51	84.54
25% RDF	109.65	109.24	62.14	64.51	8.11	9.18	9.32	10.19	23.87	24.56	74.24	84.21
C.D. (P= 0.05)	1.111	1.257	1.112.	0.493	1.000	1.114	0.211	0.219	1.19	2.11	3.111	2.141

well as nutrient availability as a source for plant uptake (Verma *et al.*, 2018). The NPK contents were affected by the application of varying amounts of NPK; the maximum absorption was seen when 75% of the RDF was applied, as opposed to other treatments. The higher fertility levels linked to improved nutrient availability and plant uptake from the soil may be the cause of the rise in uptake. Previous reports (Gupta and Handore, 2009; Khan *et al.*, 2009) have indicated comparable outcomes. Higher applications of organic manure through vermicompost, vermiwash, and other methods have been shown to have positive effects on crop development by increasing the availability of these primary nutrients at different stages, which has led to a notable improvement in nutrient content and uptake. This outcome supports Zhang *et al.*'s (2010) conclusion. Higher fertility levels led to greater nutrient absorption, which in turn produced luxuriant growth and nutrient buildup in the grain and straw, potentially increasing the intake of nitrogen, phosphate, and potassium. This is because nutrient uptake is a function of nutrient concentration and yield ha^{-1}. This might be the primary cause of the increased yields of grain and straw with the highest possible nutritional content produced by organic farming practices.

CONCLUSION

Based on the results of this study, it can be concluded that implementing organic farming methods and application of 75% RDF is a sustainable way to increase the wheat grain protein content, NPK contents and their uptake in Western Himalayan zones of Uttarakhand.

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