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Effect of different tillage and nutrient management practices on initial population and SPAD value in wheat (*Triticum aestivum* L.)

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Abstract
The field experiment was conducted to study the effects of different tillage and nutrient management practices on the initial population and SPAD value in wheat (*Triticum aestivum* L.) during the *rabi* season (2020–21 and 2021-22) at the D_2 block of the Norman E. Borlaug crop research centre of G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. The experiment was laid out in a split plot design with three replications. The experiment consisted of two factors, i.e., different tillage practises and nutrient management practices. The main plot has three treatments, i.e., zero tillage (ZT), reduced tillage (RT) and conventional tillage (CT) and a sub-plot has five treatments, i.e., RDF (N 120: P_2O_5 60: K_2O 40), RDF + FYM (5 tonnes/ha), RDF + Zinc sulphate (25 kg/ha), 75% RDF + FYM (10 tonnes/ha) and 75% RDF + FYM (5 tonnes/ha) + Zinc sulphate (12.5 kg/ha). The experiment consisted of 15 treatment combinations with different tillage practices and NMP. The result apparently indicated that the zero tillage with the 75% RDF + FYM (5 tonnes/ha) + Zinc sulphate (12.5 kg/ha) had a non-significant effect on the initial population and SPAD value. Zero tillage attains maximum value with respect to all the parameters, followed by reduced and conventional tillage. Different nutrient management practices were found to have a non-significant impact on the initial population and SPAD value. RDF + FYM (5 tonnes/ha) + Zinc sulphate (12.5 kg/ha) achieve higher values in all parameters in 75% of cases.

Keywords: RDF (Recommended dose of fertilizer), FYM (Farm yard manure), % (Per cent), Kg (Kilogram), ha (Hectare), ZT (Zero tillage), RT (reduced tillage), (conventional tillage (CT))

1. Introduction

Wheat (*Triticum aestivum* L.) is a major cereal crop in India, which accounts for 60 percent of the world's human energy requirements. It contributes more calories (20%) and protein (11%) to the world's diet than any other food crop. It is nutritious, easy to store and transport and can be processed into various types of food (Kandel *et al*., 2018) [6]. India has 30.22 mha area under wheat cultivation with a production of 107 Mt (Anonymous 2019-20) [1]. India occupies the second position among the wheat producing countries in the world after China. Wheat serves as a life-sustaining crop for our population and is, thus, considered to be the cornerstone of the nation's food security system. Undoubtedly, adoption of intensive cropping systems like "rice-wheat" is meeting the food demand of an increasing population while at the same time-consuming high input energy, resulting in environmental degradation and an increasing cost of cultivation. The recent energy crisis, high fertiliser costs, and the farming community's low purchasing power have necessitated a rethinking of alternatives to compensate for the supply of organic manure and inorganic fertilisers with appropriate tillage methods.

Due to continuous intensive tillage operations in soil, crop productivity has declined and soil has degraded in the last two decades. The conventional tillage practice makes soil more compact and a hardpan is usually developed underneath the plough layer. This obstructs the flow of water and air, inhibits root growth, and reduces crop yield. Yalcin and Cakir (2006) [15] reported that conventional tillage consumes the highest level of fuel compared to zero tillage. Conservation tillage has been recommended as a key measure to minimise the degradation of the physical and chemical properties of the soil, increase water availability to the crops, and reduce energy consumption. Marakoglu and Carman (2010) [12] reported that conservation tillage had the lowest energy input in terms of labour, tractor and other machinery inputs.

Conservation tillage is defined as any tillage practice that minimises the loss of soil and water, which often requires the presence of at least 30% of crop residue on the soil surface throughout the year.

With this definition, many practices have been considered as the measure of conservation tillage, including shallow surface tillage (reduced tillage), no-tillage (NT), crop residue mulching and subsoil mulching (Lampurlanés *et al*., 2002; Wang *et al*., 2003) [9, 18]. Conservation tillage affects the chemical, biological, and physical properties of soil, such as soil moisture, bulk density, and soil strength. Changes in soil physical properties due to the use of no-tillage (NT) depend on several factors, including differences in soil properties, weather conditions, history of management, intensity and type of tillage (Mahboubi *et al*., 1993) [19]. Tillage operations also stimulate N release from soil organic matter (Kumari and Singh, 2016) [7].

In conventional tillage system, indiscriminate use of fertilizers adversely affects the physico-chemical properties of the soil, resulting in poor wheat production. The declining response to inputs has been reported to be the major issue challenging the sustainability of wheat based cropping systems (Desai *et al*., 2015) [2]. In this situation, integrated nutrient management (INM) is a better approach for supplying nutrients to the crop by including organic and inorganic sources of nutrients. Integration of inorganic fertilizers with organic manures will not only help to sustain the crop productivity but will also be effective in improving soil health and hastening the nutrient-use efficiency (Verma *et al.,* 2006) [16]. The application of organic manure and crop residue had significant effects on the physical properties of the soil under the rice-wheat system in Punjab (Singh *et al*., 2007) [13] and Organic manures support soil biological activities besides improving soil structure, water holding capacity and other physicochemical properties of soil (Devi *et al*., 2013) [3].

Today's real agricultural challenges are resource fatigue with declining factor productivity, decreasing human resources and their rising costs and socio-economic changes. Thus, the high cost of cultivation associated with conventional tillage can be reduced with the use of zero or minimum-tillage is needed to ensure production sustainability. It is therefore essential to identify and quantify the suitable tillage and nutrient management practises that can minimize the consumption of time, money, and labour as well as sustain the productivity and profitability of wheat without loss of natural resources.

2. Materials and Method

2.1 Experimental Location

During the *Rabi* seasons of 2020-21 and 2021-22, a field experiment was carried out in the D-2 block of Norman E. Borlaug, Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar, District, Udham Singh Nagar (Uttarakhand). The research centre is located in the *Tarai* belt, 30 kilometres south of the foothills of the Shivalik range of the Himalayas, at 29 °N latitude and 79.3 °E longitude and at an elevation of 243.83 metres above mean sea level.

2.2 Weather condition

Pantnagar's climate is humid subtropical, with summer temperatures ranging from 20 °C to 43 °C and winter temperatures ranging from 0 °C to 9 °C. The average relative humidity is highest (70-90) in July and August and lowest (35-40) in April and May. The monsoon season lasts from the third week of June to the middle of September. The mean annual rainfall is about 1450 mm, of which about 70 per cent is received during the rainy season (July to September). During the experimental period, a total of 1252.8 mm of rainfall occurred during 2020-21, while 1360.9 mm of rainfall occurred during 2021-22.

2.3 Soil

The soil of experimental field was silty clay loam in texture having average high organic carbon 0.78% (Walkley and Black, 1947) [17], low available nitrogen 262 kg/ha (Subbiah and Asija, 1956) [14], high available phosphorus 19.5 kg/ha (Olsen *et al.*, 1954) [10] and medium available potassium 187 kg/ha (Jackson, 1973) [5], with slightly alkaline soil reaction pH=7.1 (Jackson, 1973) [5]. The experiment had laid out in split plot design with three replications. The experiment was consisting of two factors i.e., different tillage practises and nutrient management practices. Main plot having three treatment i.e., zero tillage, reduced tillage and conventional tillage and sub-plot having five treatments *viz.* RDF (120:60:40: N: P_2O_5:K_2O Kg/ha) RDF + FYM (5 tonnes/ha) RDF + Zink sulphate (25 kg/ha) 75% RDF + FYM (10 tonnes/ha) and 75% RDF + FYM (5 tonnes/ha) + Zink sulphate (12.5 kg/ha).

2.4 Initial population

The total number of initial population at 15 DAS were counted from 1m +1m length row from both the sides. It was further converted into initial count per meter^2 as crop row-based calculation.

2.5 SPAD value

The SPAD-502, a hand-held chlorophyll meter (Minolta Corporation, Ramsey, N.J.) was used for rapid non-destructive estimation of extractable chlorophyll in green leaves. This instrument uses a silicon photo-iodide to detect transmittance of light emitted by two light emitting diodes-through a leaf sample, one with peak eminence at 650 nm, where absorbance by chlorophyll is high and relatively unaffected by carotene and another with peak eminence at 940 nm, where absorbance by chlorophyll concentration is calculated from the transmittance through leaf tissue at these two wave length. Chlorophyll content randomly selected 20 sampled leaves from various wheat plants in net plot area was measured at 30, 60 and 90 DAS of the crop Finally, the average values on chlorophyll content were computed and expressed in SPAD unit.

3. Results and Discussion

3.1 Effect of tillage and nutrient management on initial population

Experiment findings make it abundantly evident that various tillage practices had no appreciable impact on the Initial population. Zero tillage had the highest initial count in both years, followed by reduced and conventional tillage. Tillage techniques had no discernible impact on the initial population. It might be due to, zero tillage having ability to retain soil moisture and nutrients at the initial condition as well as 25% more seed rate was applied in zero tillage so plant population is more in zero tillage. This result support with Gupta *et al*. (2000) [4], reported that zero tillage produced higher seedling emergence (2.2-4.6 per cent) than conventional system. More uniform and grater seedling emergence in zero tillage than in conventional tillage in 4 out of 6 years in the Central Great Plain due to more favorable soil water levels in seeding zone under zero tillage this result was found by (McMaster *et al*.,

2000) [11].

However, due to various nutrient management practices used during the two years study, a non-significant change in Initial population. The statistics clearly show that N5 treatment had the highest value of Initial population for the two years, followed by N4, N3, N2, and N1. In second years initial count is more compared to first year. By promoting a healthy soil structure, enhancing soil cation exchange capacity, increasing the quantity and availability of plant nutrients, raising humus content, and providing the substrate for microbial activities, the continuous application of balance nutrients with the combination of organic and inorganic sources year after year improves the physical and chemical conditions and ultimately nutrient availability is more at initial condition so N5 treatment get more no. of initial count in both the years.

Similar result was found by Kumar, S. 2018 [8], he reported that tillage practices and green manuring have non-significant influenced on initial population content during first year of experimentation but during second years it was significantly higher in zero tillage and summer manuring (dhaincha).

The interaction effect between tillage and nutrient management for mean initial population was found to be non-significant at all the growth stages.

Table 1: Effect of tillage practices and nutrient management practices on initial population of wheat

Treatments	**2020-21**	**2021-22**
	Initial population at 15 DAS	**Initial population at 15 DAS**
Tillage practices		
Zero	147	150
Reduced	146	148
Conventional	142	145
SEm±	3.71	3.06
CD (5%)	NS	NS
Nutrient management		
RDF (120:60:40)	141	143
RDF + $ZnSO_4$ (25 kg)	143	146
RDF + FYM (5 tonnes)	144	147
75% RDF + FYM (10 tonnes)	146	149
75% RDF + FYM (5 tonnes) + $ZnSO_4$ (12.5 kg)	150	153
SEm±	3.54	3.95
CD (5%)	NS	NS
A x B		
SEm±	6.14	6.84
CD (5%)	NS	NS

3.2 Effect of tillage and nutrient management on SPAD value

Number of SPAD value in wheat increased up to the 60 days and reduce thereafter at later stages during both the years. The difference in SPAD value to different tillage practices was found non-significantly at all the stages of crop growth during both the years. At 30, 90, 60 DAS, zero tillage attain numerically higher SPAD value and lowest in conventional tillage in each successive crop growth stages. Zero Tillage produced numerically higher SPAD value over the conventional tillage. This might be due to better moisture availability, soil health and micro-environment created by continuous adoption of zero tillage which enhance SPAD value. Similar result was found by Kumar, S. 2018 [8], that tillage practices have non-significant influenced on chlorophyll content during both the years.

In general, increasing in fertility levels with the combination of organic and inorganic nutrients management led to increase in SPAD value in wheat crop at different growth stages. The two year data showed that at 30, 60 and 90 DAS, N5 treatment attain maximum SPAD value compared with other treatments in both the years.

Therefore, a proper nutrition and a favourable microbiological environment may have contributed to the chlorophyll production, which ultimately increased in nitrogen content. These organic and chemical nutrients, when provided in an appropriate ratio, not only supply plant nutrition but also maintain the physical properties of the soil, such as porosity, friability, and granulation. They also improve the soil's ability to hold water, exchange cations and liberate enzymes. Low nitrogen losses brought on by the gradual release of nutrients from these organic manures is another benefit. It is well known that nitrogen plays a biological role as a crucial component of chlorophyll in the absorption of solar energy and the control of the cellular metabolism of proteins, structural components, and biological catalysis.

The interaction effect between tillage and nutrient management for mean SPAD value was found to be non-significant at all the growth stages.

Table 2: Effect of tillage and nutrient management practices on SPAD value in wheat at different stages

Treatments	SPAD value at 30		SPAD value at 60		SPAD value at 90	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Tillage practices						
Zero	35.62	36.35	41.51	42.03	31.62	32.19
Reduced	34.78	35.52	40.79	41.31	30.78	31.35
Conventional	33.55	34.29	38.86	39.38	29.55	30.12
S.Em±	0.54	0.62	0.54	0.64	0.54	0.40
CD (5%)	NS	NS	NS	NS	NS	NS
Nutrient management						
RDF (120:60:40)	33.48	34.96	39.83	40.35	29.87	30.44
RDF + $ZnSO_4$ (25 kg)	34.18	35.17	40.13	40.65	30.34	30.91
RDF + FYM (5 tonnes)	34.99	35.42	40.46	40.98	30.87	31.44
75% RDF + FYM (10 tonnes)	35.05	35.44	40.49	41.01	30.91	31.48
75% RDF + FYM (5 tonnes) + $ZnSO_4$ (12.5 kg)	35.55	35.94	41.03	41.55	31.25	31.82
S.Em±	0.24	0.59	0.54	1.37	0.41	0.47
CD (5%)	NS	NS	NS	NS	NS	NS
A x B						
S.Em±	0.41	1.02	0.94	2.37	0.71	0.81
CD (5%)	NS	NS	NS	NS	NS	NS

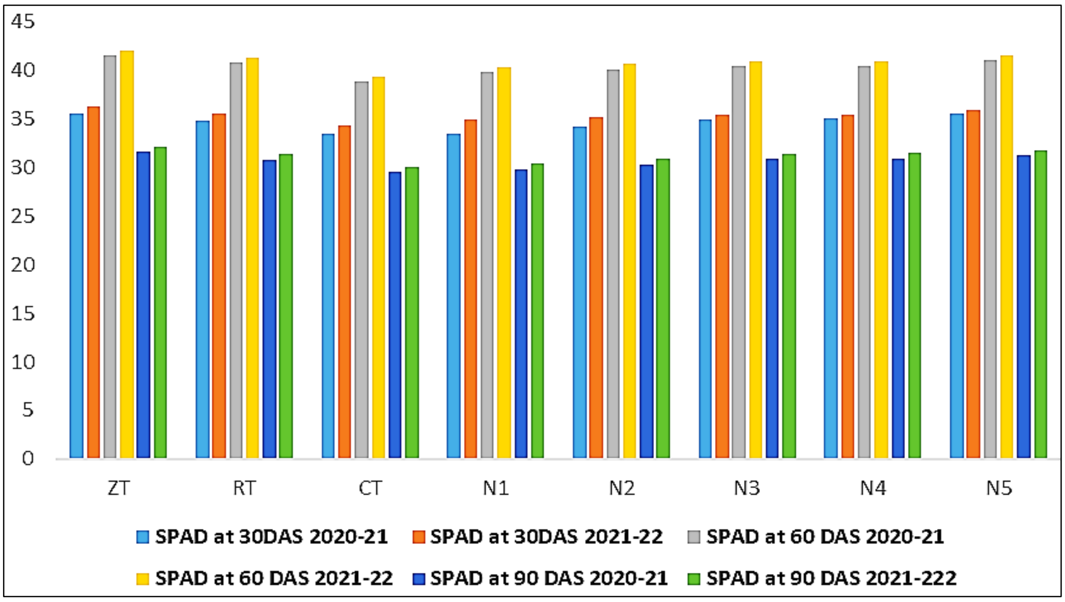

Fig 1: Effect of tillage and nutrient management practices on SPAD value in wheat at different stages

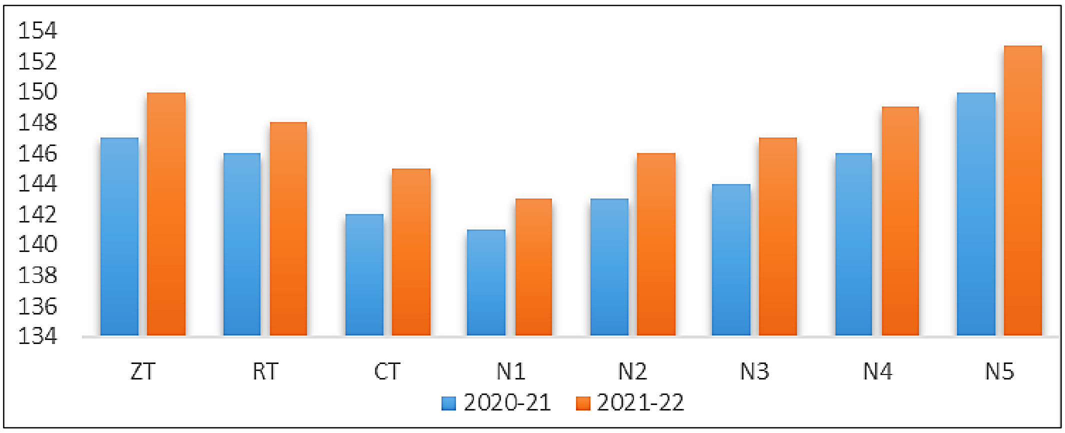

Fig 2: Effect of tillage and nutrient management practices on initial population in wheat at different stages

4. Conclusion

A field experiment was conducted during the *Rabi* seasons of 2020-21 and 2021-22 at G. B. Pant University of Agriculture and Technology, Pantnagar to study the effects of different tillage and nutrient management practices on the initial population and SPAD value of wheat. The result revealed that among the tillage practices, there was no significant difference in initial population and SPAD value, but the zero tillage produced a slightly higher value than conventional and reduced tillage. Among the various nutrient management practices, the 75% RDF + FYM (5 tonnes/ha) + Zinc sulphate (12.5 kg/ha) yielded the highest value in terms of wheat initial population SPAD value.

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