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Effect of combinations of different chemical fertilizers on growth parameters and chlorophyll of wheat (*Triticum aestivum* L. GW 366)

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ABSTRACT: Fertilizers are sources of plant nutrient that can be added to soil to supply its natural fertility. They are intended to supply plant needs directly rather than indirectly through modification of such properties as soil pH and structure. A laboratory experiment was conducted during Feb-March 2014 at Biochemistry department Govt. Holkar Science College Indore to study the effect of chemical fertilizers on the growth parameters such as germination percentage, viability percentage, root and shoot length, fresh and dry weight and vigour index and chlorophyll content in wheat (Triticum aestivum L.)seedling. The treatment consists of addition of chemical fertilizers alone or combination treatments viz, Urea, SSP, MOP, Urea + SSP, Urea + MOP, Urea + SSP + MOP to the soil and soil without fertilizer was control . The study results revealed that fertilizers alone and their combinations positively and significantly ($p<0.05$) influenced the growth parameters and Chlorophyll content of seedlings.
Key words: Fertilizers, Urea, SSP, MOP, Triticum aestivum L., growth parameter.

INTRODUCTION

Wheat (Triticum aestivum L.) is one of the major cereal crops with a unique protein, which is consumed by humans and is grown around the world in diverse environments (Abedi T. et al., 2010).Wheat is the world's most favoured staple food and provides more nourishment for humans than any other food source. It also contains carbohydrates, minerals, vitamins and fats. With a small amount of animal or legume protein added, a wheat-based meal is highly nutritious.

Wheat is foremost among cereals and as a main source of carbohydrates and protein for both human beings and animals; contains starch (60-90%), protein (11-16.5%), fat (1.5-2%), inorganic ions (1.2-2%) and vitamins (B-complex and vitamin E) (Rueda-Ayala et al., 2011).

Plants require nutrients for their growth and development. These nutrients are present in soil and continuously depleted during cultivation of crop plant. So, to overcome these problem fertilizers are used to replenish the nutrients. They are used for higher yield and effective growth of plant and agricultural products. (Ramteke A. A. et al., 2012).

In the soil, the mineral nutrients are dissolved in water and absorbed through a root of plant. However, the amounts of nutrients in soil are always unpredictable and not enough for plants growth. As a result, primary nutrients NPK which are utilized in the large amounts by crops are commonly found in blended fertilizers nowadays (Khan A. A. et al., 2009).

Fertilizers are sources of plant nutrient that can be added to soil to maintain its natural fertility. They are intended to supply plant needs directly rather than indirectly through modification of such properties as soil pH and structure. There is usually a dramatic improvement in both quality and quantity of plant growth when an appropriate fertilizer was added.

Mineral nutrients are inorganic elements that have essential and specific functions in plant metabolism which results in normal plant growth and crop production (Mengel K. and Kirkby E. A., 1987). Application of fertilizers and manures in the soil are aimed to supply nutrients to the plant. They induce disease resistance in the plants. As a result, the plants may recover from the disease or become resistant to disease (Hossain I. et al., 1996).Inorganic fertilizers include sodium nitrate, rock phosphate, limestone, ammonium nitrate, potassium nitrate, NPK fertilizers, murate of potash (MOP), and supper phosphates (Taylor M. D., 1997). Nitrogen, Phosphorus, and Potassium have great effects in plant growth and development. Their deficiencies or excesses result in marked effects on the growth and yield of crops. Nitrogen is of vital importance for plant growth due to being a part of amino acid, protein, enzymes and chlorophyll molecule. Potassium is necessary

for basic physiological functions such as formation of sugars and starch, synthesis of proteins and cell division and growth (Obreza T.A., 2003 & Abbas F. and Fares A., 2008]. Phosphorus is necessary for many life processes such as photosynthesis, synthesis and breakdown of carbohydrates and the transfer of energy within the plant (Obreza T.A., 2001). The goal of this paper was to study the effects of different combinations of chemical fertilizers on growth parameters and chlorophyll of wheat seedlings (***Triticum aestivum* L.**).

MATERIALS AND METHODS

Fertilizers -For study, recommended dosage of some selected chemical fertilizers Urea, SSP MOP and their combination were used.

Soil-The basic requirement for this experiment was soil. Soil was collected from Agriculture college campus land. Stones and other hard material removed from it. It was then grinded and filtered. This finely powdered soil was then used .

Seeds-Seeds of wheat of uniform size were selected and surface sterilized with 0.1% solution of mercuric chloride for 5min to avoid any fungal growth, followed by washing for 4-5 times with distilled water.

Experimental design : 75g soil were weighed and put into petridish and the recommended dose of chemical fertilizers (120:60:30 Kg/ha) were mixed then 45 ml of distilled water were added . The Petri disheswhere kept for 7 days in dark to generate field capacity. The experiment was completely randomized and consisted of 7 different treatments,each in triplicate.The treatments were Control (soil without fertilizers), soil +Urea (N), soil+SSP (P), soil +MOP (K), soil + Urea + SSP (N+P),soil + Urea + MOP (N+K), soil+Urea + SSP + MOP (N+P+K).

After generating field capacity seeds were then sowed ineach Petri plates . The petri plates were kept at room temperature (25±5^{o}C) for 7 days. During this period all plates were kept in sun light for at least 6 hours.

On the 7th day, the following parameters: Viability percentage, Germination percentage, shoot length, root length, fresh weight, dry weight, Vigour index and chlorophyll content were measured under standard condition.

Viability percentage: It was determined using method given by Lakon G. (1942).

Germination percentage estimation: It was estimated using method given by Rehman S. Et al., (1998).

Length of root and shoot: Root and shoot length of seedlings were recorded by using the standard centimeter scale.

Vigour index: Vigour index was calculated by using the formula as suggested by Abdul –Baki A. A. and Anderson J. D. (1973) and expressed in whole number.

Vigour Index = Germination percentage× (Root length + Shoot length in cm)

Fresh weight and Dry weight: For determining fresh weight, three seedlings were selected at random and weight of each were noted. Dry weight was determined after drying the seedlings in a hot air oven at 80 ^{0} C for 14 hours. (Kabir M et al., 2008). Fresh weight and dry weight of the seedlings were recorded using electrical balance.

Chlorophyll estimation: - chlorophyll was estimated according to the method given by Sadasivam S. and Manickam A. (1992).Chlorophyll is extracted in 80% acetone and the absorbance at 663nm and 645nm are read in a spectrophotometer using the absorption coefficients, the amount of chlorophyll is calculated.

RESULT AND DISCUSSION

Root length Table 1. showing the effect of different combination of Urea with SSP and MOP on root length (in cm) in Triticum aestivum L.

S. N.	COMBINATIONSOF FERTILIZERS	MEAN ± SD (in cm)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	12.33±0.15	-	-	_	-
2	UREA	12.93±0.32	0.02*	-	-	-
3	SSP	13.3±0.9	0.05*	0.5 ^{ns}	-	-
4	MOP	13.06±0.5	0.04*	0.7 ^{ns}	0.6^{ns}	
5	UREA+SSP	13.03±0.32	0.01*	0.4 ^{ns}	0.9 ^{ns}	
6	UREA+MOP	13.06±0.61	0.06 ^{ns}	0.4 ^{ns}	-	0.5 ^{ns}
7	UREA+SSP+MOP	15.06±0.92	0.003**	0.01*	0.04*	0.4 ^{ns}

As shown in table 1 the root length in untreated (control) seedlings of wheat was 12.33±0.15 cm while the root length of seedlings treated with Urea, SSP, MOP, N+P, N+K, NPK were 12.9±0.32, 13.3±0.95, 13.06±0.51, 13.03±0.32, 13.06±0.61 and 15.06±0.92 cm respectively.

Increase in root length was observed in all combinations as compare to control. This increase was highly significant ($p<0.01$) in NPK combination and significant ($p<0.05$) in Urea, SSP, MOP, N+P while insignificant in NK combination as compare to control. Increase in root length was significant in NPK combination while insignificant in MOP and NP combinations as compare to SSP treated seedlings. As compare to MOP change was insignificant in NK and NPK combinations.

In the present study highest increase in root length was observed in NPK combination as compare to control. Increase was significant in NPK combination as compare to urea and SSP combinations. The result of present study was supported by Nahed G. et al., (2007) who showed that NPK fertilizer significantly increased the root length of croton plant. Poole and Conover (1995) worked on Dieffenbachia maculate and Codiaeum variegatum applied different rates of NPK, they found that plants grew well, formed good root system and plant height was increased.

Calculation

Chlorophyll (a) in mg/g tissue = $12.7(A_{663}) – 2.69(A_{645}) \times \frac{V}{1000 \times W}$

Chlorophyll (b) in mg/g tissue = $22.9(A_{645}) – 4.68(A_{663}) \times \frac{V}{1000 \times W}$

Total Chlorophyll in mg/g tissue = $20.2(A_{663}) – 8.02(A_{645}) \times \frac{V}{1000 \times W}$

Table 2 . showing the effect of different combination of Urea with SSP and MOP on shoot length of Triticum aestivum L.

S No.	COMBINATIONS OF FERTILIZERS	MEAN±SD (in cm)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	8.3±0.4				
2	UREA	8.9±0.6	0.1 ns			
3	SSP	8.7±0.4	0.1 ns	0.7 ns		
4	MOP	8.9±0.9	0.2 ns	1 ns	0.4 ns	
5	UREA+SSP	8.9±0.7	0.1 ns	0.5 ns	0.7 ns	
6	UREA+MOP	8.9±0.7	0.1 ns	0.5 ns		1 ns
7	UREA+SSP+MOP	9.4±0.3	0.009**	0.2 ns	0.04*	0.23 ns

NOTE: * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 2 the shoot length (in cm) in untreated seedlings of wheat was 8.3±0.4 while the shoot length of seedlings treated with Urea, SSP, MOP, N+P, N+K, N+P+K were 8.9±0.6, 8.6±0.3, 8.9±0.8, 8.9±0.7, 8.9±0.7 and 9.4±0.3 respectively. Increase in shoot length was observed in all combinations as compare to control. This increase was highly significant ($p<0.01$) in NPK combination and insignificant in Urea, SSP, MOP, NP, NK combinations as compare to control. Change in shoot length was insignificant in all combinations as compare to Urea. Increase in shoot length was significant in NPK combination while insignificant in MOP and NP combinations as compare to SSP. Change in shoot length was observed insignificant in NK and NPK combinations as compare to MOP treated seedlings.

In the present study Triticum aestivum L. showed significant increase in shoot length with NPK combination as compare to control. Shoot length was significantly increased in NPK combination as compare to SSP. These result show similarity with the result of Malghani A. L. et al., (2010) who found that plant height increased with successive increase in NPK fertilizer.

Fresh weight

Table 3 . showing the effect of different combination of urea with SSP and MOP on fresh weight (in gm) in *Triticum aestivum* L.

S No.	COMBINATIONS OF FERTILIZERS	MEAN±SD (in gm)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	0.24±0.02				
2	UREA	0.28±0.01	0.01**			
3	SSP	0.26±0.02	0.2 ns	0.08 ns		
4	MOP	0.27±0.03	0.1 ns	0.2 ns	0.3 ns	
5	UREA+SSP	0.28±0.02	0.04*	0.6 ns	0.07 ns	
6	UREA+MOP	0.29±0.02	0.02*	0.4 ns		0.2 ns
7	UREA+SSP+MOP	0.30±0.03	0.01**	0.1 ns	0.04*	0.09 ns

NOTE: * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 3 the fresh weight (in gm) in untreated seedlings of wheat was 0.24±0.02 while the fresh weight of seedlings treated with Urea, SSP, MOP, N+P, N+K, N+P+K were 0.28±0.01, 0.26±0.02, 0.27±0.03, 0.28±0.02, 0.29±0.02 and 0.30±0.03 respectively. Increase in fresh weight was observed in all combinations as compare to control. This increase was highly significant ($p<0.01$) in Urea and NPK combinations and significant ($p<0.05$) in NP and NK combinations while insignificant in SSP and MOP combinations as compare to control. As compare to Urea change in fresh weight was insignificant in all combinations. Increase in fresh weight was significant in NPK combination while insignificant in MOP and NP combination as compare to SSP. Change in fresh weight was insignificant in NPK and NK combinations as compare to MOP treated seedlings.

In the present study Triticum aestivum L. showed highest increase in fresh weight with NPK combination as compare to control and SSP. The result of present study was supported by study of Nahed G. et al., (2007) who found that Kristalon fertilizers (NPK) caused significant increased in fresh weight of croton plants over control plant. Khaghani S. et al., (2012) indicated that application of the chemical fertilizers (NPK) significantly affect the total fresh weight of chicory (Cichorium intybus L.)

Table 4. showing the effect of different combination of urea with SSP and MOP on dry weight (in gm) in Triticum aestivum L.

S No.	COMBINATIONS OF FERTILIZERS	MEAN±SD (in gm)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	0.04±0.01				
2	UREA	0.043±0.006	0.3 ns			
3	SSP	0.043±0.006	0.3 ns	1 ns		
4	MOP	0.04±0.01	0.4 ns	0.5 ns	1 ns	
5	UREA+SSP	0.05±0.006	0.2 ns	0.5 ns	0.3 ns	
6	UREA+MOP	0.05±0.006	0.2 ns	0.3 ns		0.3 ns
7	UREA+SSP+MOP	0.06±0.006	0.03*	0.02*	0.07 ns	0.05*

NOTE: * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 4 the dry weight (in gm) in untreated seedlings of wheat was 0.04±0.01 while the shoot length of seedlings treated with Urea, SSP, MOP, N+P, N+K, N+P+K were 0.04±0.005, 0.04±0.005, 0.04±0.001, 0.05±0.005, 0.05±0.005 and 0.05±0.005 respectively. Increase in dry weight was observed in all combinations as compare to control. This increase was significant ($p<0.05$) in NPK combination and insignificant in N, P, K, NP, NK combinations as compare to untreated seedlings. Significant increase in dry weight was observed only with NPK combinations as compare to control.

Significant increase in dry weight was observed in NPK combination while change was insignificant in all other combinations as compare to Urea. As compare to SSP increase in dry weight was insignificant. Increase in dry weight was significant in NPK combination while insignificant in NK as compared to MOP.

In the present study Triticum asetivum L. showed dry weight was significantly increased in NPK combination as compare to control, Urea and MOP not to SSP. The result of present study was supported by study of Nahed G et al., (2007) who found that Kristalon fertilizers (NPK) showed significant increased in dry weight of croton plants over control plant.

Vigour Index

Table 5 . showing the effect of different combination of Urea with SSP and MOP on vigour index in Triticum aestivum L.

S No.	COMBINATIONS OF FERTILIZERS	MEAN±SD	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP

1	CONTROL	20.12±1.2				
2	UREA	21.24±0.8	0.1 ns			
3	SSP	22.03±0.6	0.04*	0.1 ns		
4	MOP	22±0.9	0.05*	0.2 ns	0.9 ns	
5	UREA+SSP	21.63±0.8	0.08 ns	0.3 ns	0.2 ns	
6	UREA+MOP	22±0.2	0.03*	0.1 ns		1 ns
7	UREA+SSP+MOP	24.43±0.8	0.004**	0.005**	0.008**	0.01**

NOTE : * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

Chlorophyll a

Table 6 . showing the effect of different combination of Urea with SSP and MOP on chlorophyll "a" (mg/g) in Triticum aestivum L.

S No.	COMBINATIONS OF FERTILIZERS	MEAN±SD chlorophyll "a" (in mg/g)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	0.085±0.02				
2	UREA	0.14±0.05	0.08 ns			
3	SSP	0.12±0.04	0.1 ns	0.3 ns		
4	MOP	0.13±0.06	0.3 ns	0.1 ns	0.8 ns	
5	UREA+SSP	0.100.01	0.2 ns	0.1 ns	0.3 ns	
6	UREA+MOP	0.15±0.03	0.02*	0.4 ns		0.3 ns
7	UREA+SSP+MOP	0.10±0.02	0.2 ns	0.3 ns	0.3 ns	0.5 ns

NOTE : * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 5 the vigour index in untreated seedlings of wheat was 20.12±1.2 while the vigour index of seedlings treated with Urea, SSP, MOP, N+P, N+K, NPK were 21.24±0.8, 22.03±0.6, 22±0.9, 21.63±0.8, 22±0.2 and 24.43±0.8 respectively. Increase in vigour index was observed in all combinations as compare to control. This increase was highly significant ($p<0.01$) in NPK combination and significant ($p<0.05$) in SSP, MOP, N+K combinations while insignificant in Urea and NP combination as compare to control. Increase in vigour index was highly significant in NPK combination while insignificant in other combinations as compare to Urea. Increase in vigour index was highly significant in NPK combination while in significant in MOP and NP combination as compare to SSP. Increase in vigour index was highly significant in NPK combination and insignificant in KA as compare to MOP. In the present study Triticum asetivum L. showed significant increase in vigour index with all combinations except Urea as compare to control. Highest increase in vigour index was observed in NPK combination as compare to Urea, SSP and MOP.

As shown in table 6 the chlorophyll "a" (in mg/g) in untreated seedlings of wheat was 0.085±0.02 while in seedlings treated with Urea, SSP, MOP, N+P, N+K, NPK were 0.14±0.05, 0.12±0.04, 0.13±0.06, 0.10±0.01, 0.15±0.03 and 0.10±0.02 respectively. Increase in chlorophyll "a" was observed in all combinations as compare to control. This increase was significant ($p<0.05$) in NK combination and insignificant in other combinations as compare to control. Increase in chlorophyll "a" was observed insignificant in all combinations as compare to Urea, SSP and MOP.

In the present study in Triticum aestivum L. showed significant increase in chlorophyll "a" with NK combinations as compare to control. Nitrogen is the basic component of chlorophyll. Lamrani et al., (1996) reported that high levels of K nutrition promoted formation of chlorophyll a and b in cucumber plant (Cucumis sativus cv Brumex)

Chlorophyll b

Table 7 . showing the effect of different combination of Urea with SSP and MOP on chlorophyll "b" (mg/g) in Triticum aestivum L.

S. N.	COMBINATIONS OF FERTILIZERS	MEAN±SD Chlorophyll "b" (in mg/g)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP

1	CONTROL	0.12±0.02				
2	UREA	0.16±0.06	0.4 ^{ns}			
3	SSP	0.12±0.02	0.4 ^{ns}	0.4 ^{ns}		
4	MOP	0.17±0.07	0.2 ^{ns}	0.9 ^{ns}	0.2 ^{ns}	
5	UREA+SSP	0.14±0.01	0.2 ^{ns}	0.5 ^{ns}	0.5 ^{ns}	
6	UREA+MOP	0.14±0.08	0.2 ^{ns}	0.7 ^{ns}		0.7 ^{ns}
7	UREA+SSP+MOP	0.13±0.12	0.2 ^{ns}	0.5 ^{ns}	0.3 ^{ns}	0.5 ^{ns}

NOTE : * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 7 the chlorophyll “b” (in mg/g) in untreated seedlings of wheat was 0.12±0.02 while in seedlings treated with Urea, SSP, MOP, N+P, N+K, NPK were 0.16±0.06, 0.12±0.02, 0.17±0.07, 0.14±0.01, 0.14±0.08 and 0.13±0.12 respectively. Increase in chlorophyll “b” was observed in all combinations as compare to control. Increase was insignificant in all combinations as compare to control.

Total Chlorophyll

Table 8. showing the effect of different combination of Urea with SSP and MOP on total chlorophyll (mg/g) in Triticum aestivum L.

S. N.	COMBINATIONS OF FERTILIZERS	MEAN ±SD Total Chlorophyll (in mg/g)	P VALUE W.R.T. CONTROL	P VALUE W.R.T. UREA	P VALUE W.R.T. SSP	P VALUE W.R.T MOP
1	CONTROL	0.20±0.04				
2	UREA	0.30±0.11	0.1 ^{ns}			
3	SSP	0.24±0.06	0.2 ^{ns}	0.2 ^{ns}		
4	MOP	0.29±0.14	0.2 ^{ns}	0.9 ^{ns}	0.3 ^{ns}	
5	UREA+SSP	0.21±0.04	0.4 ^{ns}	0.1 ^{ns}	0.3 ^{ns}	
6	UREA+MOP	0.29±0.07	0.07 ^{ns}	0.4 ^{ns}		0.9 ^{ns}
7	UREA+SSP+MOP	0.23±0.007	0.2 ^{ns}	0.2 ^{ns}	0.9 ^{ns}	0.5 ^{ns}

NOTE : * for significant, ** for highly significant, *** extremely significant, ns for insignificant.

As shown in table 8 the total chlorophyll (in mg/g) in untreated seedlings of wheat was 0.20±0.04 while in seedlings treated with urea, ssp, mop, N+P, N+K, NPK were 0.30±0.11, 0.24±0.06, 0.29±0.14, 0.21±0.04, 0.29±0.07 and 0.23±0.007 respectively. Increase in total chlorophyll was observed in all combinations as compare to control. Increase was insignificant in all combinations as compare to control.

CONCLUSION

Continuous cropping with low or no fertilizer inputs, nutrient losses through harvest, soil erosion and leaching has led to decline in soil fertility. Among improvement possibilities, the nutritional requirements play a major role. Nitrogen, Phosphorus and Potassium are major essential elements required for physiological mechanisms of plant growth.

The result obtained from the present study indicates that the application of NPK in combination increased the growth parameters: root length, shoot length, fresh weight, dry weight and vigour index of wheat seedlings over control. It shows that all macronutrients in combinations increased the growth of the wheat seedlings due to seedlings obtain all the nutrient in sufficient amount. Fertilizers combination increases the chlorophyll content of seedlings and they improve the nutritive value of wheat.

NPK fertilizers greatly influenced the growth of wheat seedlings compared to control seedlings. This improvement might be due to that the plant cell can’t carry out its life processes if it lacks these nutrients. Growing plants must have nitrogen to form new cells and the rate of growth then becomes very nearly proportional to the rate at which nitrogen is supplied Bidwell R. G. S., (1974). Phosphorous has been called “the key to life” because it is directly involved in most life processes. Phosphorous in the cell becomes united with carbon, hydrogen, oxygen, nitrogen and other elements to form complex organic molecules. It is an essential component of genetic material of the cell nucleus.

Potassium is needed in relatively large amounts by all plants. It aids in the uptake of other nutrients and their movement within the plant. The presence of potassium and other ions in solution helps in maintaining the osmotic concentration necessary to keep the cell turgid Devlin R. M. (1972).

Pal and Biswas (2005) recorded that the best results on growth parameters when tuberose plants were fertilized with NPK at 15:15:20 gm^{-2}. Also, Khan M. A. and Iftikhar A., (2004). on gladiouls concluded that N. P. K. at the different rates enhanced growth characteristics.

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