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Impact of Herbicide Metribuzin with or Without Fertilizers On NH_4^+ -N_2, P, K and Micro Nutrients in Aligarh Soil

Ritu Singh
Department of Botany, Aligarh Muslim University, Aligarh-202002, India

Abstract : *A pot experiment was performed to determine the effect of metribuzin amended with different fertilizers (NPK and vermicompost) on the availability of ammonium nitrogen, phosphorus, potassium (NH_4^+ -N_2 , P, K) and Cu, Mn, Zn and Fe with different concentrations of metribuzin (100, 175 and 250gai.) in Aligarh soil. Pots were also filled with recommended rates of NPK and vermicompost under wheat plants. Among the herbicide concentrations metribuzin @175 gai. proved beneficial as compared to other two doses. Metribuzin@250 gai. proved deleterious for soil nutrients as compared to other two concentrations. While the use of NPK and vermicompost proved better in enhancing the nutrients , which may have exerted a positive effect on wheat yield as compared to herbicide use only. Vermicompost increased the micronutrients the most.*
Keywords*: Fertilizers, macro and micro nutrients, metribuzin and vermicompost.*

I. Introduction

Application of herbicides in modern agriculture is considered to be an efficient and economic practice to control weeds. This may have significant implications for productivity of soil, sustainability of agriculture. Metribuzin is incorporated as a post-emergent soil applied herbicide to control weeds in wheat, potato, tomato and others. Although the herbicide may have a beneficial impact on the agricultural productivity, nonetheless, environmental hazards of these chemicals are of much concern because the transformation of nutrients, turnover and mineralization of organic substances and their cycling all are dependent upon the enzymes (Subhani et al., 2001) which finally affect these nutrients in turn . It has been estimated that only 0.1 % of applied pesticide reached the target and the remaining 99.9 % affects the environment (Singh and Singh, 2006). All the herbicides get into the soil which is the main reservoir and one of the most precious natural resources. NPK are essential nutrients which are required in large quantity for various plant physiological processes and growth. Micronutrients are defined as elements which are essential or toxic in small quantities to microorganisms, plants and animals including humans. They play critical roles in the biological process of organisms (Yu et al., 2011). In addition, excessive mineral fertilization and modern cultivation practices are adding to the detereioration of soil fertility status. (Gaind and Nain, 2007). Environmental and soil concern have prompted the agricultural research to look for improved management strategies. The use of organic manures like vermicompost may hold a good promise in this direction. As very few studies have been reported on the influence of metribuzin with NPK and vermicompost affecting nutrients as well as growth of wheat.

II. Materials and Methods

A pot experiment was performed in three replications, in the green house of the Aligarh Muslim University, Aligarh on the sandy loam soil. The soil was collected from the adjacent district of U.P. (Aligarh). The soil had the following properties: pH-8.49, organic carbon- .308 % (Walkley and Black ,1947), CEC (meq/100g)- 2.21 (Ganguly,1951) and % $CaCO_3$ -3.45 (Piper, 1942).

Before the start of the experiment earthen pots of 10” diameter were placed in the net house .Each pot was filled with 5Kg of soil of Aligarh district. Healthy looking and clean seeds of wheat var. PBW 343 were surface sterilized with 0.01% aqueous solution of mercuric chloride. These were washed with double distilled (DDW) and dried in shade. Prior to sowing of seeds fertilizers treatment was done according to the treatments. The NPK fertilizers were applied @ 120:60:40 Kg ha $^{-1}$ and vermicompost was added @ 5Kg ha $^{-1}$. These were calculated on the basis of their composition and that one hectare of land contains 2×10^{-6} Kg effective soil (Singh, 1988). The herbicide named metribuzin (a member of triazinone family) was obtained from a local agricultural dealer store in Aligarh. Metribuzin was applied as three different concentrations. Each pot was given 300 ml of water at the alternate days uniformly up to the maturity of crop to maintain the proper moisture within the pots. Wheat was harvested at the maturity. Five samplings were undertaken at 0, 30, 60, 90 and 120 DAS (days after sowing) for soil nutrients study. The ammonium nitrogen (NH_4^+ N_2) was estimated by the method of Kearney and Nelson (1982), available phosphorus by Olsen (1954), available potassium by flame photometer and micro nutrients by Lindsay and Norvell (1978) method.

The results are the mean of the three replicates. Data were subjected to an analysis of variance (ANOVA) using least significance difference test and comparing the difference between specific treatments by Gomez and Gomez (1984).

III. Results And Discussion

The effects of metribuzin on ammonium nitrogen, phosphorus and potassium (NH_4^+ - N_2, P, and K) and micro nutrients (Cu, Mn, Zn and Fe) availability in Aligarh soil with or without (NPK and vermicompost) were recorded. Information on soil nutrients (macro and micro) with metribuzin and fertilizers with wheat crop is lacking. The study proved that soil contamination with metribuzin disturbs the soil nutrient status adversely in comparison to control, although the actual disorder depends on the rate of herbicide. Overall the availability of NH_4^+ - N_2, P and K was maximum with metribuzin@175 gai. followed by metribuzin@100 gai (Table 1-3). As in our study the availability of NH_4^+ - N_2, P, and K was negatively correlated to the herbicide concentrations. Metribuzin@250 gai. proved to be the least effective in increasing these nutrients in soil. The availability of these macro nutrients increased up to 90 DAS later decreased slightly (Fig. 1). NPK+ metribuzin @ 175 gai. proved to be the best interaction for these (NH_4^+ - N_2, P and K) nutrients increase which may have further improved the growth and yield of wheat as compared to other two concentrations of metribuzin.

While on the other hand the micronutrients availability was maximum at 30 DAS (days after sowing) then declined at 60 DAS which was quite sharp. At later stages the decrease became slower and followed similar trend with both fertilizers. V+ metribuzin @ 175 gai. proved to be the best interaction for these (Cu, Mn, Zn and Fe) nutrients increase (Fig. 2). Noteworthy is the fact that the concentrations of both type i.e. macro and micro nutrients were higher in fertilized soils (NPK and vermicompost) as compared to herbicide treatment only indicating the role of the two fertilizers for increasing these nutrients.

As earlier reports have shown that use of herbicides results in increase of some bacterial and fungal population, which ultimately affects nutrients in soil (Tag-AL-Din et al., 1989 and Aamil et al., 2004), as increase in the available NH_4^+ - N_2 may be due to increase in actinomycetes and nitrifying bacteria . Similar results were also reported by Tiyagi et al. (2004) and Das and Debnath (2006) in chick pea and rice respectively. Similarly, the *Pseudomonas* spp. of bacteria become dominant after herbicide addition in soil, which is responsible for more release and solubilisation of phosphate in soil. Increase in available K might be either due to release of fixed K from mineral lattice or solubilisation effects caused by certain fungi (*A. niger*) and bacteria (*Bacillus siliceous*), which may have decomposed the alumino silicate minerals thus released portion of K contained therein. Such results are also reported by others (Basal and Gupta, 2010).

While considering the role of the two fertilizers, use of NPK with metribuzin @ 175 gai. proved most effective for available NH_4^{+-} N_2, P and K increase. This could be due to their effect on the supply of assimilates as it has been proved earlier that nitrogen and potassium are essential for photosynthesis for better growth and development. Thus increased the availability directly by NPK and indirectly by herbicides. While on the other

Table -1 Effect of herbicide doses on available ammonium nitrogen (NH_4^+–N_2) of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	Available NH_4^+–N_2 (mg kg^{-1}) 0 DAS				30 DAS			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	7.50	11.64	9.90	9.68	13.60	18.90	15.20	15.90
100	7.50	11.64	9.90	9.68	14.30	21.30	16.80	17.47
175	7.50	11.64	9.90	9.68	15.40	22.50	18.75	18.88
250	7.50	11.64	9.90	9.68	12.60	16.20	13.80	14.20
Mean	7.50	11.64	9.90		13.98	19.73	16.14	

	60 DAS				90 DAS			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	16.40	21.60	18.90	18.97	21.40	26.40	24.40	24.07
100	17.90	24.90	20.10	20.97	24.20	28.90	26.00	26.37

175	19.50	27.60	21.30	22.80	25.90	31.20	27.80	28.30
250	15.20	19.90	16.20	17.10	20.00	24.60	21.70	22.10
Mean	17.25	23.50	19.13		22.88	27.78	24.98	

	120 DAS			
	Herbicide	**NPK**	**Vermi compost**	**Mean**
Control	19.50	24.90	22.50	22.30
100	21.30	25.40	23.70	23.47
175	23.70	27.60	26.10	25.80
250	18.75	23.70	21.20	21.22
Mean	20.81	25.40	23.38	

C.D. at 5%

DAS	**Fertilizer**	**Herbicide**	**Interaction**
0	NS	0.169	NS
30	0.255	0.295	0.497
60	0.308	0.355	0.600
90	0.387	0.447	NS
120	0.353	0.408	NS

Gai. – gram active ingredient.

Table - 2 Effect of herbicide doses on available phosphorus of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	**Available phosphorus (mg kg^{-1})**							
	0 DAS				**30 DAS**			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	2.00	3.00	2.12	2.37	3.00	5.64	5.20	4.61
100	2.00	3.00	2.12	2.37	3.12	6.72	5.76	5.20
175	2.00	3.00	2.12	2.37	3.60	8.12	6.52	6.08
250	2.00	3.00	2.12	2.37	2.12	5.12	3.44	3.56
Mean	2.00	3.00	2.12		2.96	6.40	5.23	

	60 DAS				**90 DAS**			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	3.12	5.72	5.40	4.75	4.52	6.72	5.52	5.59
100	3.44	7.72	6.12	5.76	5.20	8.52	8.12	7.28
175	4.00	9.00	6.64	6.55	6.64	10.32	10.42	9.13
250	3.00	5.40	4.00	4.13	3.72	6.52	4.52	4.92

Mean	3.39	6.96	5.54		5.02	8.02	7.15	

	120 DAS			
	Herbicide	**NPK**	**Vermi compost**	**Mean**
Control	3.60	6.12	5.32	5.01
100	3.80	8.12	7.40	6.44
175	4.24	9.52	8.32	7.36
250	3.52	5.70	4.24	4.49
Mean	3.79	7.37	6.32	

C.D. at 5%

DAS	**Fertilizer**	**Herbicide**	**Interaction**
0	NS	0.042	NS
30	0.077	0.089	0.150
60	0.084	0.097	0.164
90	0.106	0.123	0.207
120	0.092	0.106	0.180

Table – 3 Effect of herbicide doses on available potassium of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	**Available potassium (mg kg^{-1})**							
	0 DAS				**30 DAS**			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	29.12	32.48	30.24	30.61	30.24	36.96	34.72	33.97
100	29.12	32.48	30.24	30.61	34.72	41.44	36.96	37.71
175	29.12	32.48	30.24	30.61	35.84	42.56	38.08	38.83
250	29.12	32.48	30.24	30.61	29.12	33.60	32.48	31.73
Mean	29.12	32.48	30.24		32.48	38.64	35.56	

	60 DAS				**90 DAS**			
	Herbicide	**NPK**	**Vermi compost**	**Mean**	**Herbicide**	**NPK**	**Vermi Compost**	**Mean**
Control	32.48	39.40	36.96	36.28	54.88	66.08	56.00	58.99
100	35.84	38.90	38.08	37.61	58.24	73.92	59.36	63.84
175	36.96	39.20	39.20	38.45	62.72	75.04	67.20	68.32
250	30.24	34.72	34.12	33.03	49.84	62.72	53.76	55.44
Mean	33.88	38.06	37.09		56.42	69.44	59.08	

	120 DAS			
	Herbicide	**NPK**	**Vermi compost**	**Mean**
Control	36.96	59.36	53.76	50.03
100	39.20	61.60	58.24	53.01
175	41.44	74.80	60.48	58.91
250	35.84	50.40	40.32	42.19
Mean	38.36	61.54	53.20	

		C.D. at 5%	
DAS	**Fertilizer**	**Herbicide**	**Interaction**
0	NS	0.538	NS
30	0.547	0.632	1.066
60	0.556	0.642	1.084
90	0.944	1.091	1.841
120	0.786	0.908	1.532

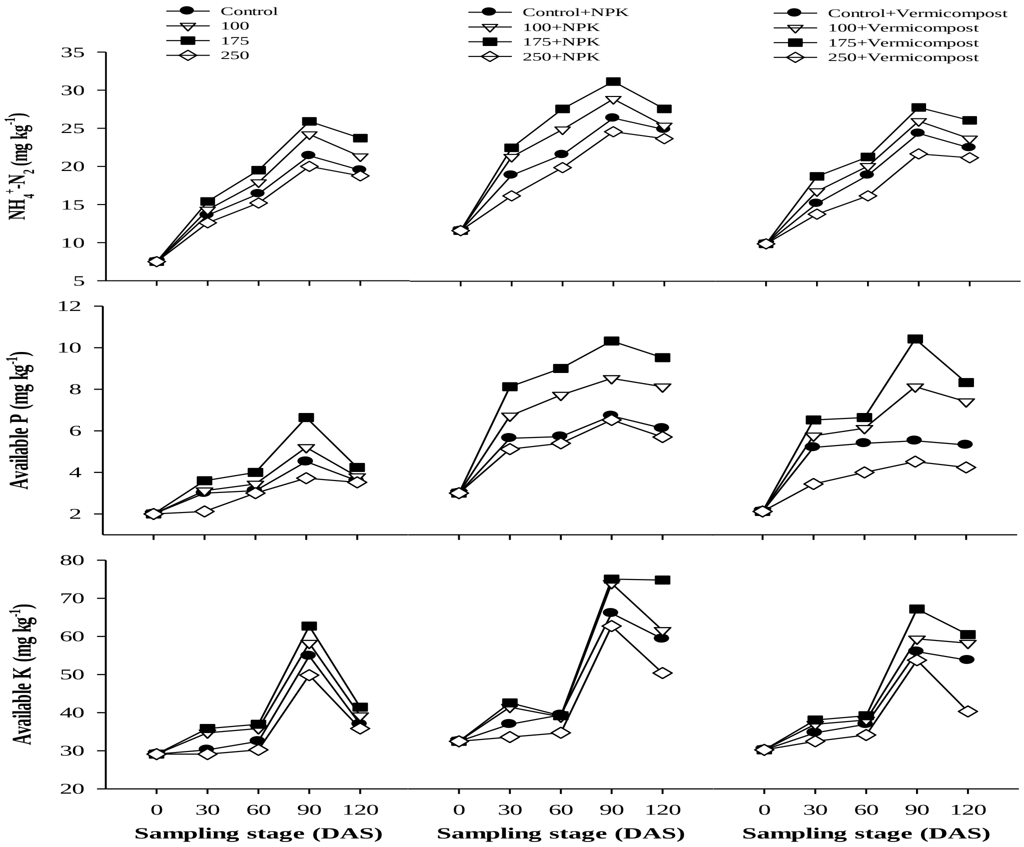

Figure -1 Showing available ammonium nitrogen, P and K in soil at different time intervals of crop growth.

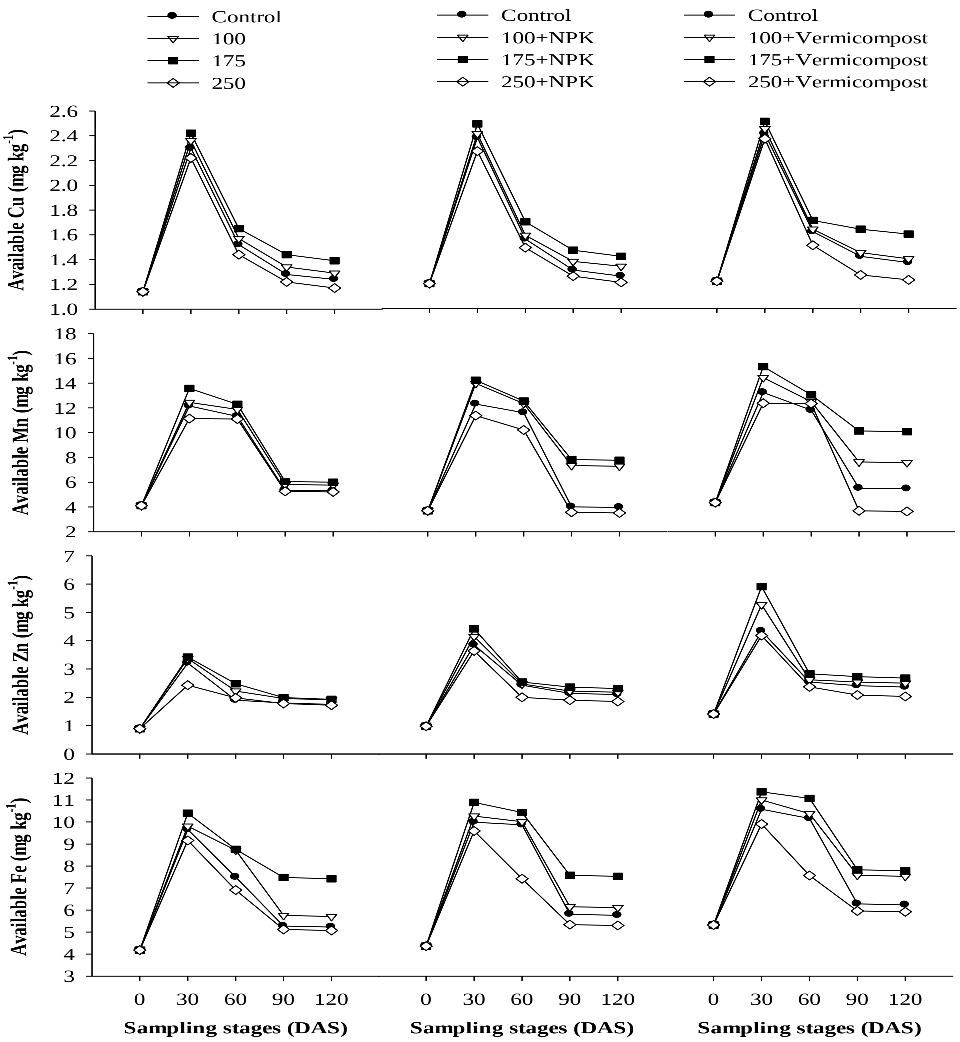

Figure-2 Showing available Cu, Mn, Zn and Fe in soil at different time intervals of crop growth.

hand use of vermicompost with metribuzin @ 175 and 100 gai. proved better in increasing available nutrients as it is already enriched with many essential nutrients and organic carbon (Azarmi et al., 2008). Thus use of herbicides with fertilizers may have exerted a favourable effect on wheat growth and yield as noted by us. Jastrzebska and Kucharaski (2007) also noted that recommended or medium dose positively affected the barley yield. Reason behind this may be that higher dose of herbicide may have exerted a negative influence on soil nutrients by disturbing the soil physicochemical and biological properties etc. and also these chemicals are transported in all plant tissues, cellular structures which may finally lead to yield loss also (Kucharski and Wyszkowska, 2008).

IV. Conclusion

The main objective of the study was to assess the effects of metribuzin in Aligarh soil with and without NPK and vermicompost on both type of nutrients and on wheat growth and yield . Use of metribuzin @ 250 gai. proved excessive for Aligarh soil as it is aselective herbicide with systemic mode of action , have very low degradation at higher temperaturealso and greatly affects the photosysnthesis. Thus affects largely soil as well as plant. Our study proved that inorganic fertilizer (NPK) with metribuzin @175 gai. proved better for wheat as well as for soil. However use of NPK works faster as compared to organic ones , but on the other hand use of organic fertilizer (vermicompost) in term of long term sustainability, fertility of soil and environmental point of view may be a good strategy.

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