Journal of Crop and Weed, 15(3): 220-224 (2019)
ISSN- O : 2349 9400 ; P : 0974 6315

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Long term effect of fertilizer on weed dynamics

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Received : 07.11.2019 ; Revised : 17.11.2019 ; Accepted : 27.11.2019
DOI: https://dx.doi.org/10.22271/09746315.2019.v15.i3.1263

ABSTRACT

A study on effect of long term use of fertilizers on weed dynamics in maize – wheat cropping system was conducted at Birsa Agricultural University, Ranchi during 2013 to 2016 The treatments included three levels of N 40, 80 and 120 kg ha^{-1}, P_2O_5 0, 40 and 80 kg ha^{-1} and two levels of K_2O, 0 and 40 kg ha^{-1} each for maize and wheat in fixed plots. The treatment absolute control $N_0P_0K_0$ was also included in the treatments. The experiment was conducted under confounded design with three replications. Minimum weed population and dry matter accumulation was recorded in maize during all the years under absolute control ($N_0P_0K_0$). As the levels of nitrogen, phosphorus and potash increased, the weed population and dry matter accumulation also decreased. The interaction of N, P and K revealed that with increasing combination of N and P, weed dry matter accumulation increased upto 40 kg P ha^{-1} and it reduced at 80 kg P ha^{-1}. With increase of N and K level the weed dry matter reduced. The maize grain yield continued to increase up to highest level of nutrient applied. In case of wheat, as the level of P and K combinations increased, the grain and weed dry matter accumulation also increased. Combination of P with 40 or 80 kg N ha^{-1} without K increased weed dry matter accumulation as well as wheat grain yield, while, weed dry matter accumulation reduced with addition of 40kg K ha^{-1} with N and P irrespective of their levels. Wheat yield increased with reduced weed dry matter

Keywords : Nutrient combination, weed dynamics, weed dry matter

Weeds are considered to be most important critical factor in limiting the productivity of crops. They compete for resources like nutrient, water and light. The weed flora, their density and dry matter changes due to various factors like crops grown, land situation like upland, medium land or low land, cropping pattern followed, irrigation methods, nutrients and moisture present in the soil, their amount, soil pH, climatic and weather parameters and also methods of weed control like manual, mechanical and chemical methods adopted. Among these factors the role of nutrients in weed dynamics needs to be studied as nutrients are the most important production factors affecting yield. Farmers use fertilizers to provide essential nutrients as per crop requirements. In spite of application of recommended fertilizers the farmers may not get desired crop yield owing to presence of weeds in the field. The weeds exhaust nutrients from the soil more competitively than crop plants. The quantum of yield loss varies from place to place based on weed flora species and their population as well as level of nutrients present in the soil. Neve *et al.* (2009) have found that soil nutrient content also affect weed population and diversity index as well as farm land community structure. Change in soil nutrient content by fertilization can alter weed diversity index, weed composition, natural succession of the weed community and affect crop biomass and yield *(*Tarek *et al.*, 2008). Basic nutrients requirements of all plants are same but due to their different root structures or mycorrhizal associations or tolerance to nutrient imbalances, or in their efficiency at converting nutrients into growth, they differ in their ability to access nutrients. Hence, maintaining or improving soil fertility is an element of weed management (Frick and Johnson, 2002). Gharde *et al.*(2018) observed from 10 years weed management trials from 18 states of India that yield losses were high in case of soybean (50-76%) and groundnut (45-71%) while, in direct-seeded rice and maize, yield losses varied from 15-66% and 18-65% respectively. Weeds cause economic loss of about USD 11 billion in India on crops like groundnut, soybean, green gram, maize, direct-seeded rice, wheat and transplanted rice. Considering above facts in view, a study on weed dynamics was conducted in Agronomical Research Farm of Department of Agronomy, Birsa Agricultural University, Ranchi to find out the effect of long term use of fertilizers on weed dynamics in maize – wheat cropping system.

MATERIALS AND METHODS

The experiment on long term effect of nutrient N, P and K started from 1985. However, their effect on weed dynamics and yield of maize – wheat cropping sequence was performed during 2013 to 2016. The treatments included N 40, 80 and 120 kg ha^{-1}, P_2O_5 0, 40 and 80 kg ha^{-1}, and two levels of K_2O 0 and 40 kg ha^{-1},. The nutrients were applied both to maize and wheat in fixed plots. The nitrogen was applied in splits, fifty percent applied as basal and rest fifty percent was applied at knee height and before emergence of tassel in case of maize while, at crown root initiation (after first irrigation) and at maximum tillering stge in case of wheat. The treatments were replicated four times under confounded design.

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Table 1: Effect of long term use of nitrogen, phosphorus and potassium on weed density and weed dry matter in maize

Treatments	Weed density and weed dry matter in maize at 50 DAS							
	Total weed population (m^{-2})				Total dry matter (g/ m^{-2})			
	2013	**2014**	**2015**	**2016**	**2013**	**2014**	**2015**	**2016**
$N_0P_0K_0$	13.8 (200)	16.6 (283)	17.08 (300.87)	18.72 (363.77)	3.6 (12.9)	4.0 (16.2)	4.16 (17.51)	4.54 (21.17)
N level								
N_{40}	22.5 (525)	21.7 (480)	22.44 (513.86)	24.58 (618.62)	4.9 (25.2)	4.6 (21.7)	4.65 (21.72)	5.08 (26.17)
N_{80}	18.9 (364)	19.5 (382)	20.11 (408.49)	22.02 (492.34)	3.9 (16.3)	4.4 (19.3)	4.26 (19.05)	4.66 (23.05)
N_{120}	17.8 (322)	19.0 (374)	19.64 (402.33)	21.52 (485.69)	3.4 (12.4)	4.3 (19.2)	4.68 (22.27)	5.12 (26.82)
LSD(0.05)	**1.2**	**0.9**	**0.92**	**1.01**	**0.3**	**0.2**	**0.24**	**0.27**
P level								
P_0	22.0 (502)	22.5 (513)	23.27 (549.84)	25.49 (663.21)	3.0 (9.2)	3.4 (11.3)	3.49 (12.11)	3.82 (14.62)
P_{40}	20.3 (418)	19.7 (396)	20.35 (425.35)	22.29 (512.36)	5.0 (26.3)	5.3 (27.6)	5.45 (29.51)	5.97 (35.57)
P_{80}	17.0 (290)	18.0 (327)	18.57 (349.49)	20.34 (421.08)	4.1 (18.4)	4.7 (21.4)	4.64 (21.43)	5.08 (25.85)
LSD(0.05)	**1.2**	**0.9**	**0.92**	**1.01**	**0.3**	**0.2**	**0.24**	**0.27**
K level								
K_0	20.4 (429)	20.9 (441)	21.58 (474.58)	23.65 (572.49)	4.7 (23.9)	4.7 (22.5)	4.87 (24.15)	5.32 (29.13)
K_{40}	19.1 (378)	19.2 (382)	19.88 (408.55)	21.77 (491.95)	3.4 (12.0)	4.2 (17.6)	4.19 (17.88)	4.58 (21.56)
LSD(0.05)	**1.0**	**0.7**	**0.75**	**0.83**	**0.2**	**0.2**	**0.20**	**0.22**

RESULTS AND DISCUSSION

Effect of N, P and K on weed dry matter at 50 DAS and maize grain yield

Minimum dry matter accumulation was recorded in maize during all the years under absolute control *i.e*. $N_0P_0K_0$. As the levels of nitrogen, phosphorus and potash increased from 40 to 120 kg ha^{-1}, 0 to 80 kg ha^{-1} and 0 to 40 kg ha^{-1} respectively, the weed population and dry weight accumulation also decreased accordingly (Table 1). The reduced weed dry matter accumulation under absolute control may be owing to suboptimal level of nutrient available in the soil which was not sufficient enough to support growth and development of even weeds.

As the level of N and K increased from 40 to 120 kg N ha^{-1} and 0 to 40 kg K_2O ha^{-1} the weed dry matter accumulation reduced while increase in P_2O_5 from 0 to 40 kg ha^{-1} the weed dry matter accumulation increased but thereafter it reduced. The maize grain yield continued to increase up to highest level of nutrient applied (Fig.1). With increasing combination of N and P weed dry matter accumulation increased up to 40 kg P ha^{-1} and it reduced at 80 kg P ha^{-1}. The maize grain yield continued to increase up to highest level of combination of N and P. With increase of N and K level the weed dry matter reduced. The yield was less affected. With increase in K level from 0 to 40 kg ha^{-1} reduced weed dry matter. The maize grain yield increased up to highest level of combination of P and k (Fig.3). The increasing level of nutrient N, P, K provided selective advantage to maize and wheat crop plants thereby had an competitive edge over weeds thus it suppressed it.

Effect of combinations of N, P and K on weed dry matter at 50 DAS and maize grain yield

As per increase of N level from 40 to 120 kg ha^{-1} without P & K and also with 40 kg K ha^{-1} continued to reduce weed dry matter and increased grain yield. Increase in P level from 0 to 40 & 80 kg ha^{-1} along with increasing N & K level weed dry matter and maize grain yield continued to increase. Weed dry matter at 120 kg

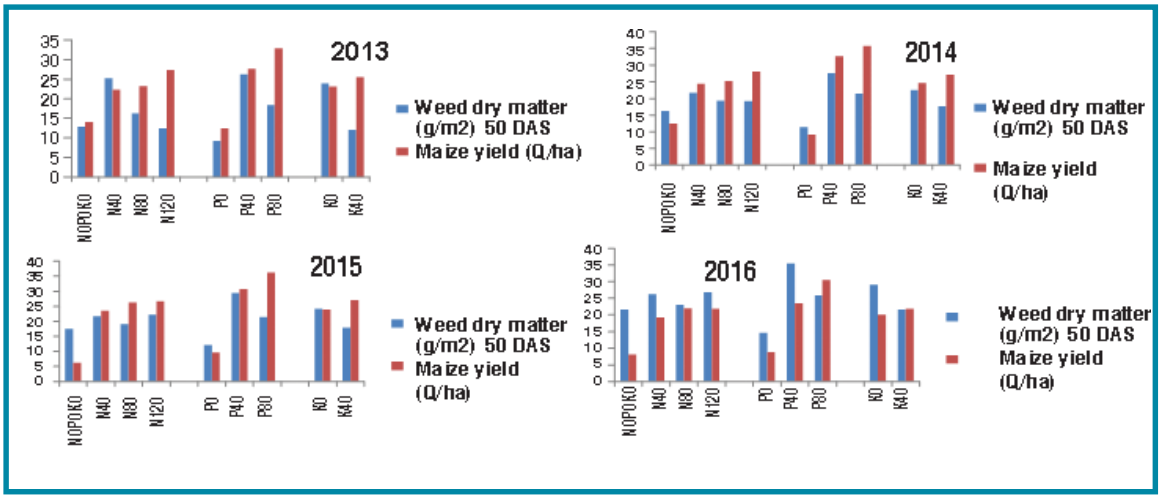

Fig. 1: Effect of long term application of nitrogen, phosphorus and potassium on weed dry matter and maize grain yield

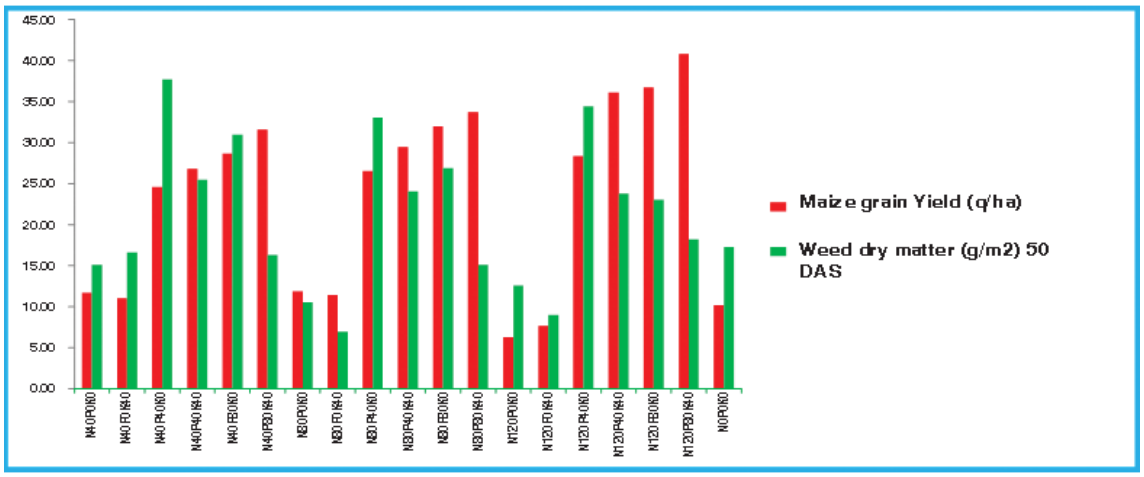

Fig.2: Effect of nutrient combinations on maize grain yield and weed dry matter at 50 DAS (pooled of 4 years)

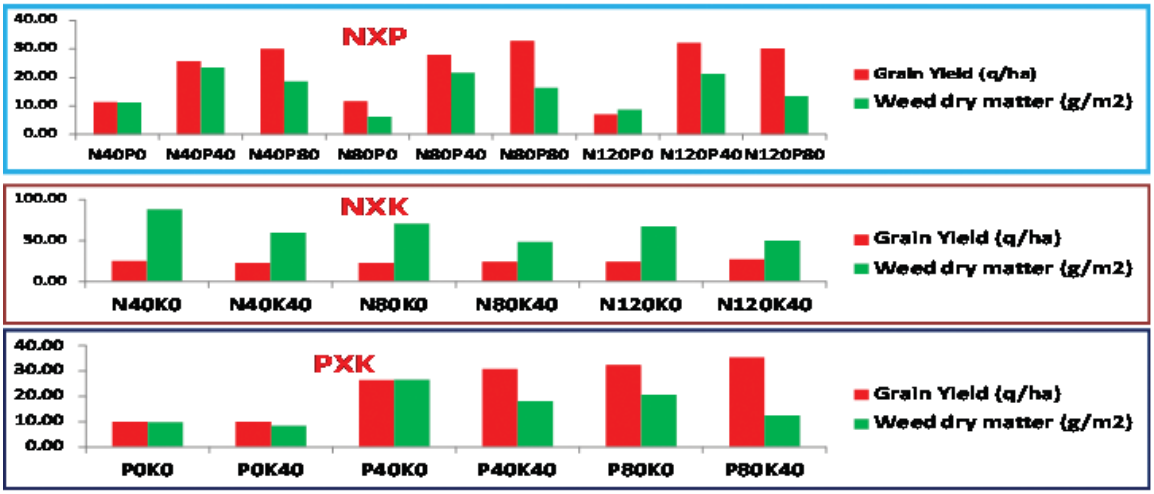

Fig. 3: Interaction effect of N P K on maize grain yield and weed dry matter (Average of 2013 to 2016)

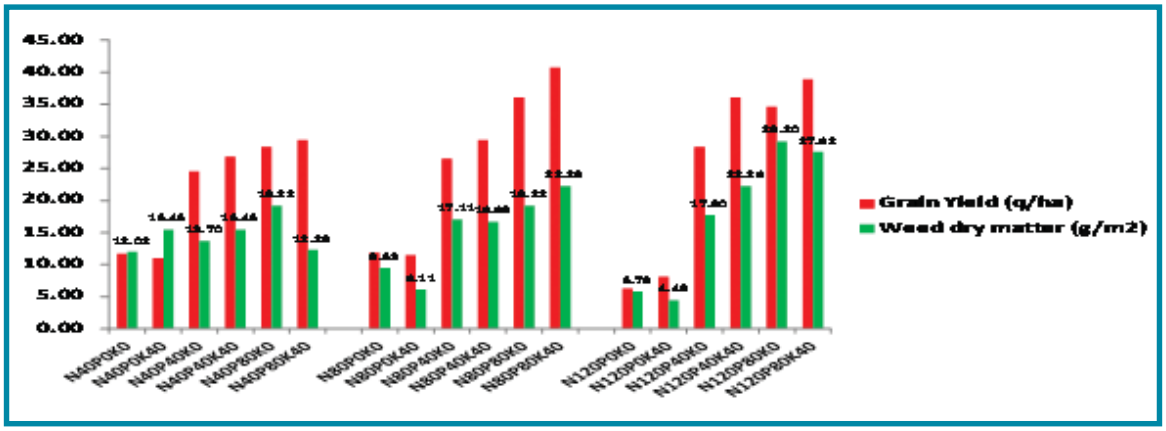

Fig. 4: Effect of combination of N x P x K on weed dry matter at 50 DAS and maize grain yield (Pooled of 2013 to 2016)

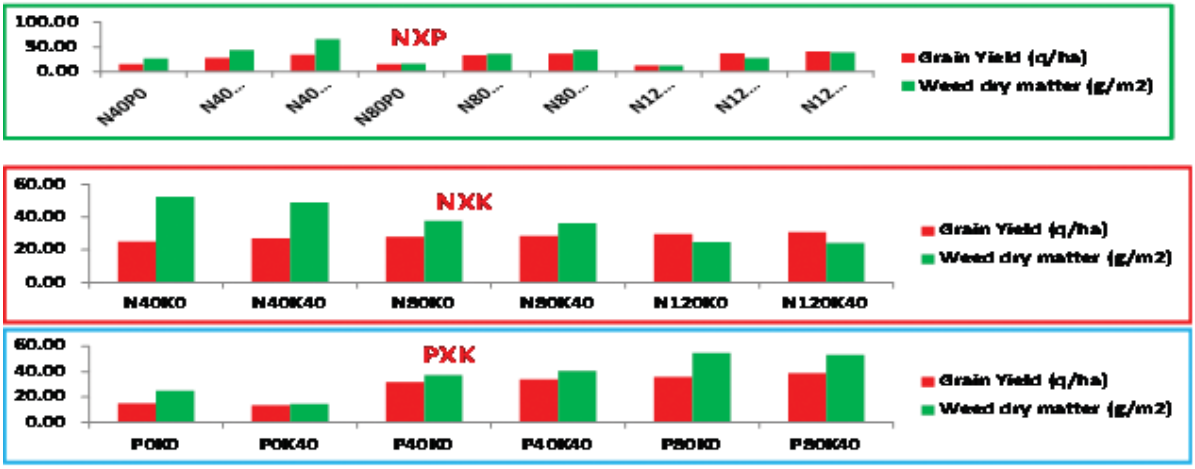

Fig. 5: Interaction effect of N, P and K on wheat grain yield and weed dry matter (Average of 2013-14 to 2015-16)

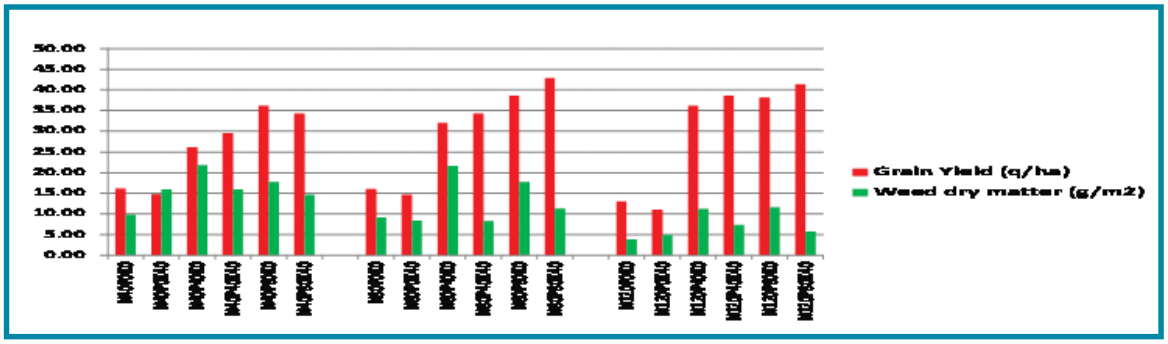

Fig.6: Effect of combination of N, P and K on weed dry matter and wheat grain yield (Average of 2013-14 to 2015-16.)

N ha^{-1} along with P & K irrespective of dose increase weed dry matter thereby reduced maize yield compared to 80 kg N ha^{-1} with P & K combinations (Fig.2).

Interaction effect of different levels of N, P and K on maize grain yield and weed dry matter

With increasing combination of N and P weed dry matter increased up to 40 kg P ha^{-1} and it reduced at 80 kg P ha^{-1}. The maize grain yield continued to increase up to highest level of combination of N and P. With increase of N and K level the weed dry matter reduced. The yield was less affected. With increase in K level from 0 to 40 kg ha^{-1} reduced weed dry matter. The maize grain yield increased up to highest level of combination of P and K (Fig. 3).

Interaction effect of N, P, K on wheat grain yield and weed dry matter

The wheat yield increased with reduced weed dry matter at higher level of N and P; N and K combination. As the level of P and K combinations increased the grain and weed dry matter continued to increase. Combination of P with 40 or 80 kg N ha^{-1} without K increased weed dry matter as well as wheat grain yield. Addition of 40 kg K with N and P irrespective of their levels reduced weed dry matter (Fig.6).

As the level of N and K increased from 40 to 120 and 0 to 40 kg k_2O ha^{-1} the weed dry matter reduced while increase in P_2O_5 from 0 to 40 kg ha^{-1} the weed dry matter increased but thereafter it reduced. The maize grain yield continued to increase up to highest level of nutrient applied.

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