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Residual effect of fertility levels, wheat varieties and zinc on growth and yield of succeeding baby corn (*Zea mays* L.)

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Abstract
A field experiment was conducted to study the residual effect of varying levels of fertility, wheat varieties and zinc on growth, and yield of succeeding baby corn (*Zea mays* L.) during summer season of 2017 at the Agricultural Research Farm, Department of Agronomy, Institute of Agricultural Sciences. Significantly higher average plant height, number of leaves, LAI, chlorophyll content, total dry matter accumulation, were recorded with residual effect of 125% recommended dose of fertilizers (RDF). Similarly, baby corn, baby cob, and green fodder yields also followed the same trend. Varieties did not show any residual effect but increasing levels of zinc application up to 12 kg ha^{-1} significantly enhanced growth and yield of baby corn over control. In general, application of different levels of NPK and zinc to previous crop significantly influenced the growth attributes and yield of succeeding baby corn.

Keywords: Baby corn, fertility level, growth, yield, zinc

Introduction
Baby corn has gained popularity as a vegetable in India nowadays and a new market for baby corn ears has emerged. With an assured market for their produce, farmers are finding baby corn an attractive crop to cultivate. It is unfertilized maize ear which is harvested within 2 to 3 days of silk emergence. The plant enters into the reproductive phase within 45–55 days after sowing and being a short-duration crop (60–70 days), it can be grown 3 to 4 times in a year. Its nutrient requirement is very high and the importance of nutrient in maize becomes even more relevant when it is grown as baby corn because of its high plant density and very short duration.

Continuously exhaustive rice-wheat cropping system with inadequate and imbalanced nutrient use is leading to deterioration of soil fertility and soil health (Bohra *et al*., 2007) [1, 7] which has an adverse effect on crop yield. Nutrient management is an option for maintain soil health and crop productivity (Pradhan *et al*., 2017; Verma *et al*., 2018; Pradhan *et al*., 2020; Verma *et al*., 2020) [6, 7, 10, 11]. Balanced fertilizers not only help in maintaining the highest productivity but also provides stability in crop production.

Micronutrient deficiency in Indian soils has emerged as one of the essential constraints to crop productivity. Deficiency of micronutrients over the last three decades has grown in both, magnitude and extent due to current practices like increased use of high analysis fertilizers, use of high yielding crop varieties and increase in cropping intensity. (Manojlovic *et al*., 2019). The rising micronutrient deficiencies more particularly of zinc (Zn) is claimed to be the major reason for the declining land and water productivity of crops. (Das *et al*., 2020) [3]. Human dependence upon cereals with a poor Zn status, especially in developing countries, deepens the gap between the available amount, and the amount required for good health, which is 40–50 ppm (Cakmak., 2010) [2]. Low dietary intake of Zn and very little dietary diversity appear to be the major reasons for the widespread occurrence of Zn deficiency in human populations (White *et al*., 2009) [12]. Diets consumed predominantly in the developing world are based on cereals which are poor in the amount and bioavailability of Zn. Enrichment of cereal crops with Zn is, therefore, an important global challenge and a high-priority research area. Hence, if Zn-deficient soils are used for cultivating cereals, then their availability in the harvested produce is decreased to many folds. Therefore, it is essential to sustain a satisfactory level of Zn in the soil. In modern agriculture, keeping in mind status of the soil health, it is well recognized that application of micronutrients is in a need with macro nutrients.

Materials and Methods
Field experiment was conducted during summer season of 2017 in Agricultural Research Farm Department of Agronomy, Institute of Agricultural Sciences, BHU, Varanasi (UP).

The first crop was grown with a treatment combination of eighteen, which involved main plot treatment consisted with combination of two fertility gradients, i.e. F_1-100% and F_2-125% RDF (Recommended dose of fertilizers) and three varieties of wheat i.e. PBW-502, HD-2967, HUW-234. The sub plot comprised of three levels of Zinc application i.e. 0, 6, 12 kg Zn ha^{-1}. The treatments were replicated thrice to avoid the effect of heterogeneity. The treatments within main plots and sub-plots were randomly allocated in each replication of the experimental unit as per standard procedure. The recommended dose of fertilizer was applied as per the treatment through urea, DAP, MOP and zinc sulphate respectively. Half quantity of N with full quantity of P, K and Zn as per treatment were applied as basal dose and the remaining dose of nitrogen was top dressed through urea at 30 DAS and at knee height stage. After the harvest of the wheat, the baby corn crop was grown only with half basal dose of nitrogen, phosphorus and potassium but no Zn in the same layout. The data collected from the experiment at harvest were to statistically analysed as per by Gomez and Gomez (1984).

Results and Discussion

Effect of treatment on plant growth of baby corn

The growth attributing characters like plant height, number of green leaves, LAI, chlorophyll content, dry matter accumulation was affected significantly by different levels of fertility. Application of 125% RDF recorded significantly higher growth parameters over 100% RDF. This might be due to availability of sufficient residual major nutrients (N, P and K), resulted significant improvement in growth characters of succeeding crop. Various researches have also reported the similar findings Sheoran *et al.* (2017); Pradhan *et al.*, 2017 [6, 7, 11]; Verma *et al.*, 2018 [6, 7, 10, 11]; Pradhan *et al.*, 2020 [6, 7, 11]; Verma *et al.*, 2020 [6, 7, 10, 11] and Rathiya *et al.*, 2020 [9]. Nitrogen being a major constituent of chlorophyll, amino acids and protein, P being the component of energy compounds, *viz.* ATP, NADP and potassium serving as an activator or cofactor for various enzymes involved in the photosynthesis and CO_2 fixation could have promoted the satisfactory plant growth, photosynthetic surface and yield structures. The residual effect of wheat varieties did not show any significant difference on the growth attributes of baby corn. However, maximum growth values were obtained in the plot with residual effect of variety HUW-234.

Similarly, marked effect in growth attributes of baby corn was also observed with application of zinc. The highest growth components in subsequent baby corn crop were due to the higher residual soil Zn extracted from the plots where higher Zn treatment was applied to the preceding wheat crop. It might be due to rapid division and elongation of cells with balanced and adequate Zinc supply, Zinc involved in directly and indirectly as co-enzyme in photosynthetic process which provide substrate for growth and development which seemed to be the reason behind the favourable influence on all the growth attributes of baby corn.

Effect of treatment on plant yield of baby corn

Among the residual effect of nutrient, application of 125% RDF recorded significantly higher yield of succeeding baby corn and cob yield. Residual effect of 125% RDF increased the baby corn yield by 7.99%. This may be due to the higher quantity of residual nutrients associated with the higher fertility levels applied during the wheat crop, which influences the crop growth, yield attributes and thus ultimately higher yield of succeeding baby corn. The results were in the close agreements with the findings of Rathiya *et al.*, 2020 [9] who reported that residual nutrient had positive effect on the yield of succeeding crop registered maximum seed yield.Varieties failed to show any significant residual effect on the yield of baby corn. However, maximum growth and yield values were obtained in the plot with residual effect of variety HUW-234.

The effect of residual zinc recorded maximum yield with 12 kg Zn ha^{-1} but remained on par with application of 6 kg Zn ha^{-1}. The increase in Zn levels to the preceding wheat crop increased the residual soil Zn contents for the succeeding crop that had positive impact on the yield and yield components of the subsequent baby corn. Zinc plays an important role in the biosynthesis of IAA and initiation of primordial for the reproductive part and results favourable effects on metabolic process of the plant system. The results were in close the conformity with findings of Keram *et al.* (2012) [4]. The application of Zn either through soil and leaves lead to a direct effect on all the yield parameters (Ranjbar and Bahrmaniar 2007) [8].

Table 1: Residual effect of varying levels of fertility, wheat varieties and zinc on growth attributes of baby corn

Treatment	Plant height (cm)	Green leaves per $plant^{-1}$	Dry matter $plant^{-1}$	LAI	Chlorophyll content (SPAD)
Fertility levels					
100% RDF	142	10.15	93	3.71	36.28
125% RDF	152	11.17	99	3.90	40.94
S. Em+	2.7	0.12	1.7	0.03	0.71
C.D. 5%	8.4	0.39	5.4	0.08	2.25
Varieties					
V1 - PBW-502	145	10.58	96	3.78	38.00
V2 - HD-2967	154	10.55	95	3.76	37.93
V3 - HUW-234	143	10.85	98	3.87	39.90
S. Em+	3.3	0.15	2.1	0.03	0.87
C.D. 5%	NS	NS	NS	NS	NS
Zinc levels (kg/ha)					
Z1-0	140	10.22	91	3.61	36.37
Z2-6	150	10.78	98	3.87	39.44
Z3-12	153	10.97	99	3.94	40.01
S. Em+	1.7	0.13	0.8	0.04	0.37
C.D. 5%	5.1	0.39	2.3	0.11	1.08

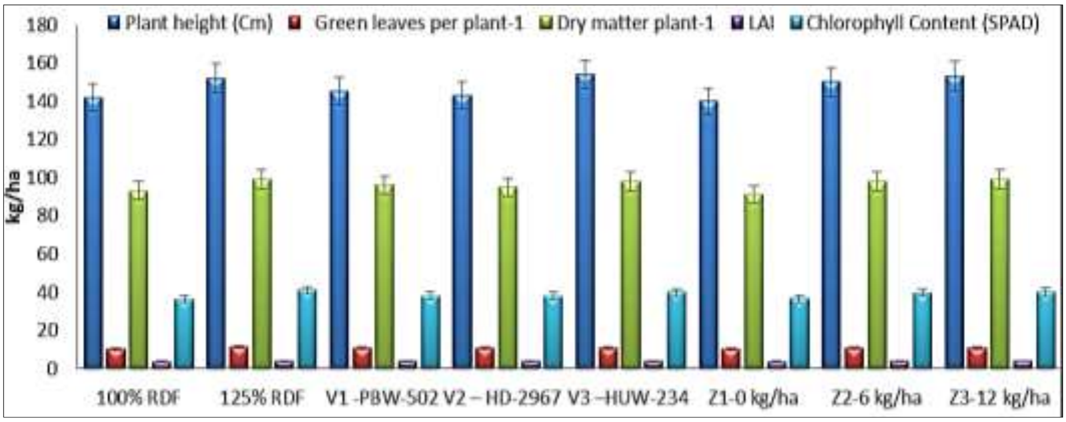

Fig 1: Residual effect of varying levels of fertility, wheat varieties and zinc on growth attributes of baby corn

Table 2: Residual effect of varying levels of fertility, wheat varieties and zinc on yield of baby corn

Treatment	Total baby cob yield (kg ha^{-1})	Total baby corn yield (kg ha^{-1})	Green fodder yield (kg ha^{-1})
Fertility levels			
100% RDF	4692	1263	16900
125% RDF	5054	1364	17974
S. Em±	72.2	29	335
C.D. 5%	227.5	90	1055
Varieties			
V1 – PBW - 502	4844	1300	17457
V2 – HD - 2967	4763	1260	17130
V3 – HUW - 234	5012	1379	17725
S. Em±	88.4	35	410
C.D. 5%	NS	NS	NS
Zinc levels (kg/ha)			
Z1-0	4701	1263	16936
Z2-6	4930	1334	17508
Z3-12	4988	1343	17867
S. Em±	45.2	20	171
C.D. 5%	132.0	59	498

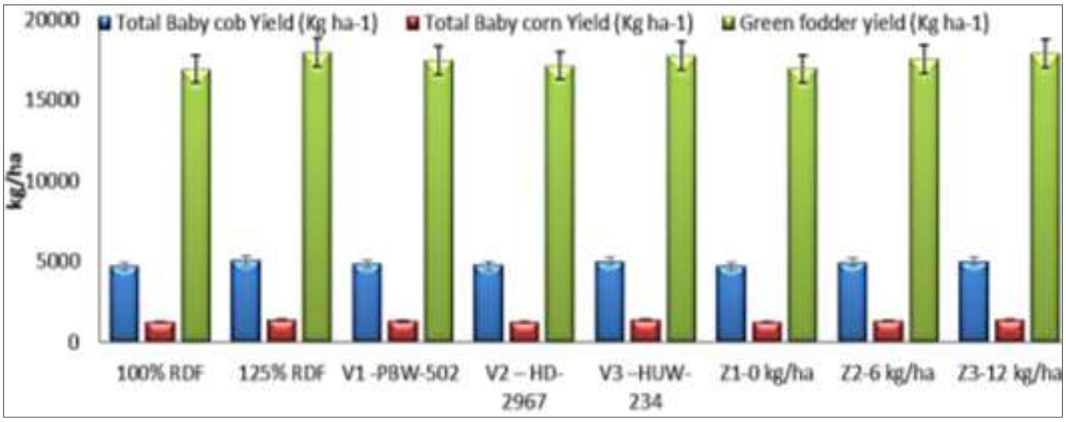

Fig 2: Residual effect of varying levels of fertility, wheat varieties and zinc on yield of baby corn

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