ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 13, Issue, 11, pp. 64251-64253, November, 2023
https://doi.org/10.37118/ijdr.27495.11.2023

RESEARCH ARTICLE OPEN ACCESS

EFFECT OF FOLIAR APPLICATION OF WATER SOLUBLE PHOSPHONITRILE DERIVATIVES IN DIFFERENT CONCENTRATIONS ON YIELD OF GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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ARTICLE INFO

Article History:
Received 17th August, 2023
Received in revised form
20th September, 2023
Accepted 22nd October, 2023
Published online 27th November, 2023

Key Words:

Malnutrition, Micronutrients, Foliar Application, Phosphonitrile Derivatives (PNC),NPK fertilizer, Groundnut (Arachis hypogaea L.*)*

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ABSTRACT

India is one of the highest ranking countries in the world for the number of children suffering from malnutrition. This problem is due to insufficient intake of micronutrients through staple foods. Micronutrients are various essential elements such as Ca, Zn, Mg, Fe and Cu required by organism in small quantities to maintain health. The present investigation entitled "Effect of foliar application of water soluble Phosphonitrile derivatives in different concentrations on yield of Groundnut (Arachis hypogaea L.)" was conducted at the Organic Research Farm, Karguanji, Department of Chemistry, Institute of Basic Science, Bundelkhand University Jhansi (U.P.) During the year 2021-22 in Kharif season. The experiment was comprised of seventeen treatments which were laid out in Randomize Block Design with three replications. Result showed that the quality parameters like no. of pod, no. of seeds and yield of the crop was recorded maximum in treatment with PNC (T_9 to T_{16}) comparision to treatments with NPK (T1 to T8). However, all quality parameters are noticed minimum in treatment T17 (Control). There was a positive linear relationship between growth/yield and phosphonitrilic derivatives, the best yield was obtained with T_{16} hence this was recommended for the production of groundnut in the study area.

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Citation*: *Anupam Agarwal and Dr. Chitra Gupta. 2023. "Effect of foliar application of water soluble phosphonitrile derivatives in different concentrations on yield of groundnut (*Arachis hypogaea L.)". *International Journal of Development Research*, 13, (11), 64251-64253.

INTRODUCTION

Micronutrient deficiencies affect a large segment of the population in the developing world (WHO 2002). Iron (Fe) and Zinc (Zn) are receiving increased attention globally as their deficiency is widespread, particularly in developing countries. Iron deficiency primarily affects women and children. The consequences of malnutrition are varied and far reaching. In infants and young children, under nutrition and growth retardation are associated with reduced physical activity, lowered resistance to infection, impaired intellectual development and cognitive abilities, and increased morbidity and mortality. Despite the large-scale intervention programmers, Fe-deficiency anaemia remains the most widely prevalent nutritional problem in the world. Plant foods remains the major source of micronutrients for the poor in developing countries since animal products, which are rich in micronutrients, are beyond their reach. Enhancing the Fe and Zn concentrations of plant foods that are consumed daily may prove to be an effective and convenient way of overcoming deficiencies of these micronutrients in human diets (Bluish 1996; Krushak & Dellapenna 1999; House *et al.,* 2002). Groundnut *(Arachis hypogaea L.)* is important cash and food grain legume crop grown for its edible oil and protein rich kernels (Kamara *et al*., 2011). It contains about 50% oil, 25-30% protein, 20% carbohydrate and ash which make a substantial contribution to human nutrition (Fageria *et al*., 1997) and 5% fiber. Groundnut is cultivated in the semi-arid and subtropical regions of the world and grown in nearly 100 countries on six continents (Ajeigbe *et al*., 2015). It is the world's greatest source of edible oil, ranking 13th among food crops and world's fourth most significant oil seed crop (Ramanathan, 2001). India is second largest producer of groundnut and its oil after China. Annual production of groundnut in India was 9690 thousand tones. As it is grown in rain-fed regions of the country, so, its production is highly vulnerable to rainfall deviations and display huge fluctuations during different years. Being an Oil seed crop, it is most vulnerable to phosphorus deficiency, which in turn result in nitrogen as well as potassium deficiency. Phosphorus is one of the most essential nutrient elements needed by all leguminous plants for their growth and development (Chude *et al*., 2012). In Groundnut, Phosphorus is known to play an important role in increasing root growth, nutrient and water use efficiency, and also in enhancing yield. The requirement of phosphorus in nodulating legumes is higher when compared to non-nodulating crops. Due to the important role played by phosphorus in the physiological processes of plants, application of phosphorus to soil deficient in the nutrient leads to increased groundnut yield. Although legumes can fix their nitrogen, they often need phosphorus for proper growth and yield (Asiedu *et al*., 2000). Till date no compound with Phosphonitrile has been used for supplying macro and micronutrients as Mg, Ca. Fe, Zn,

Cu etc. to the plant. So Phosphonitrile cyclic derivatives having aminoacid and metal salts, are synthesized for enhancing the quality and growth/yield of leguminous crops mainly groundnut because phosphonitrile itself degrade and generates phosphates and ammonia which are ecofriendly and used as manure to the plant. Therefore this study was carried out to determine the effects of foliar spray of such phosphonitrile derivatives (PNC) having plant nutrients itself comparision to NPK on the growth / yield of groundnut in the study area.

MATERIALS AND METHODS

Experimental Site: The field experiment was laid out on newly developed plot, a part of organic research farm Karguan Ji of Bundelkhand University, Jhansi (Uttar Pradesh). This farm is situated behind the Bundelkhand University in foot hills of Kaimasan Mata Temple. Geographically, the Karguwa Ji Farm of Bundelkhand University, Jhansi is situated at a 25°27'03.2 North latitude and 780.36'48.4"E longitude. The attitude level of Bundelkhand University Jhansi plains is about 257m above mean sea level.

Test Crop: The variety GJG-22 was used as the test crop and seeds were collected from Krishi Vigyan Kendra (KVK), Jhansi.

Land Preparation: The land was prepared by ploughing and cross ploughing with a power tiler. Cowdung, poultry manure, vermicompost and mustard oil cake were also applied as the organic treatments.

Experimental Design and Layout: The experiment was laid out with 18 treatments in randomized block design (RBD) and three replications. The entire experiment area was divided into 17 plots. The unit plot size was 1.25m x 1.25 m; the plots were separated from each other by 30 cm spaces. The treatments were randomly distributed.

Seed Treatments: The collected seeds from KVK, Jhansi were dipped into water for a night to enhance emergence. Then the seeds were treated with *Rhizobium* culture.

Sowing of Seeds: The seeds were sown @ 2-3 seeds per hill on 14th July 2021, in furrows at a depth of 3-5 cm with the spacing of 15 cm x 30 cm. by dibbling method.

Intercultural and other Operations: Seeds started germination 7 days after sowing (DAS). Thinning was done two times; the first thinning was done at 12 DAS and the second was at 18 DAS to maintain optimum plant population in each plot. The crop was weeded as necessary. There was no infestation of insect pests and diseases in the field during the experimental period and no control measures were adopted. Five plants from each treatment were randomly selected and marked with a sample tag.

Treatments: There were 17 treatments including one control treatment. All the phosphonitrile derivatives treatment were done as foliar application on the flower with the help of spry method. The treatment combinations for the experiment were as follows.

Table 1. Treatments Combination with their Symbols

S. No.	Symbols	Treatments
1	T_1	Foliar spray of NPK @ 1%
2	T_2	Foliar spray of NPK @ 2%
3	T_3	Foliar spray of NPK @ 3%
4	T_4	Foliar spray of NPK @ 10%
5	T_5	Foliar spray of NPK @ 15%
6	T_6	Foliar spray of NPK @ 20%
7	T_7	Foliar spray of NPK @ 25%
8	T_8	Foliar spray of NPK @ 30%
9	T_9	Foliar spray of PNC @1%
10	T_{10}	Foliar spray of PNC @2%
11	T_{11}	Foliar spray of PNC @3%
12	T_{12}	Foliar spray of PNC @10%
13	T_{13}	Foliar spray of PNC @15%
14	T_{14}	Foliar spray of PNC @20%
15	T_{15}	Foliar spray of PNC @25%
16	T_{16}	Foliar spray of PNC @30%
17	T_{17}	Control

Harvesting: The crop was harvested after 130 DAS.

Data Collection: The following data were recorded – number of leaves and plant height (cm) were recorded from 4th week upto 12th week. Then after harvesting no. of pods per plant, weight of pods per plant, no. of seeds per plant, 100 seed weight (g) and yield per plot.

RESULT AND DISCUSSION

The analysis of data revealed significant differences between NPK and PNC derivatives (Table 3). Data in Table (3) indicated clearly

Table 2. Effect of Foliar Application of Water Soluble Phosphonitrile Derivatives in Different Concentrations on Number of Leaves and Plant Height of Groundnut

Treatments	Number of Leaves Weaks after Planting					Plant Height (cm) Weeks after planting				
	4	6	8	10	12	4	6	8	10	12
T_1	17.00	25.00	34.00	41.00	21.00	7.2	9.1	12.6	18.3	20.5
T_2	21.00	29.00	37.00	43.00	17.00	9.3	13.6	15.3	21.2	23.3
T_3	24.00	31.00	47.00	51.00	23.00	11.2	15.4	18.6	24.4	28.6
T_4	29.00	39.00	51.00	57.00	27.00	14.3	17.6	21.3	25.1	31.4
T_5	31.00	43.00	56.00	63.00	30.00	15.1	18.5	22.6	26.3	33.8
T_6	34.00	47.00	58.00	65.00	31.00	15.7	19.7	24.7	29.4	36.9
T_7	32.00	47.00	61.00	67.00	34.00	16.3	21.1	28.6	32.4	38.2
T_8	34.00	49.00	70.00	74.00	33.00	17.6	22.4	29.6	33.2	40.3
T_9	39.00	59.00	86.00	93.00	43.00	11.5	15.6	18.9	23.5	34.7
T_{10}	34.00	62.00	101.00	111.00	47.00	14.3	17.6	21.3	27.4	37.4
T_{11}	43.00	77.00	109.00	146.00	53.00	15.0	19.7	24.7	29.4	36.9
T_{12}	44.00	77.00	121.00	128.00	47.00	16.4	21.2	27.3	31.5	39.4
T_{13}	39.00	83.00	141.00	200.00	77.00	17.3	23.1	29.8	32.6	41.3
T_{14}	54.00	86.00	148.00	213.00	81.00	17.6	25.4	31.6	38.7	44.6
T_{15}	56.00	92.00	151.00	218.00	92.00	19.4	26.3	34.4	41.6	47.3
T_{16}	61.00	97.00	162.00	224.00	94.00	21.3	30.3	39.3	44.7	50.2
T_{17}	11.00	21.00	32.00	41.00	19.00	8.6	10.7	14.8	17.6	22.9

Table 3. Effect of Foliar Application of Water Soluble Phosphonitrile Derivatives in Different Concentrations on Yield of Groundnut

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}	T_{16}	T_{17}
No. of Pods Per Plant	8	11	14	16	16	17	19	23	18	22	25	31	36	41	45	49	9
Weight of Pods Per Plant	12.3	14.7	16.32	17.20	17.31	19.32	21.67	26.31	23.67	27.67	30.23	40.13	46.23	52.37	61.85	67.52	11.2
Number of Seeds Per Plant	14	19	29	34	31	36	41	47	41	43	44	47	51	70	79	84	13
Weight of Seeds Per Plant	7.34	7.38	9.34	10.63	11.32	12.34	13.11	14.66	13.34	14.98	16.87	28.13	28.31	31.65	34.66	39.32	7.31
Weight of 100 Seeds	24.13	24.61	28.69	31.91	33.11	24.61	27.65	28.60	31.61	32.53	39.43	54.20	61.52	66.38	68.25	70.53	21.64
Fresh Yield / Ten Plant	360.53	423.36	491.63	547.65	567.32	590.36	646.34	650.85	684.35	845.58	944.65	1240..15	1359.56	1611.32	1844.63	1953.52	2079.47

that all the traits were increased gradually with increasing concentration of PNC derivatives from 1% to 30%. The positive and linear relationship between PNC and growth/yield of the crop is an indication of the vital roles. PNC plays an important role in the development of crops particularly leguminous crops such as groundnut. The application of PNC at a higher concentration significantly increased the number of leaves and plant height (Table 2). The highest number of leaves and plant height were recorded at 30% PNC which was significantly higher than all other treatment of NPK. The shortest plant was observed in the control which was significantly lower than what was obtained with other levels of PNC application. The data presented in table 3 revealed that significantly highest number of pods/plant (49.0) were obtained with application of PNC derivatives which were statistically better than NPK application. These results are in harmony with those of by (Sisodiya et al., 2017) revealed that application of sulphur had significant effect on uptake of micronutrients (Fe, Mn, Zn and Cu). This increase in uptake of nutrients by the crop was attributed to improved physical and chemical properties of the *rhizoshere* of the crop, due to application of sulphur. (Pancholi et al., 2017) Reported that supply of sulphur in adequate amount helps in the development of floral primordial i.e.reproductive parts, which results in the development of pods and kernels in plants. (Yadav et al., 2017) reported significantly yield with application of gypsum followed by SSP.

CONCLUSION AND RECOMMENDATION

From these results, it can be concluded that foliar spraying with 30% PNC derivatives which is an Inorganic polymer improves the growth / yield of groundnut under the condition of this experiment. Thus farmers need to apply these PNC derivatives, for getting more number of pods/ plant and optimum yieldof groundnut. PNC derivative was found to be better than NPK derivatives due to its biodegradable nature and is cost efficient. Weight, growth efficiency and taste of the groundnut was found to be better after using foliar spray. It is therefore recommended that for the cultivation of groundnut in this study area, 30% concentration PNC derivative is required and should be used.

ACKNOWLEDGEMENT

The author is thankfull to Dr. Satyavir Singh Solanki, Department of Agriculture Science, Bundelkhand University, Jhansi (U.P.) India for supporting field work and necessary soil related laboratory facilities.

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