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Article

Effect of Nano Urea on Growth and Yield of Potato in Lower Gangetic Planes of West Bengal

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Abstract:

In today's world, it is the need of the hour to adopt new technology to sustain the production of the future. Nanotechnology is gaining popularity for its efficiency in various applied fields of science. In agriculture, nanomaterials have a huge impact on the efficiency of fertilizers pesticides, etc. As it requires very fewer quantities and has a negligible residual effect the environment is safe with the innovation of Nano fertilizer. Keeping this view into account an experimental Trial at a farmer's field was carried out at Berui village in the Hooghly District of West Bengal during the winter (rabi) season of 2019 – 20 under the supervision of Berui Cooperative, KVK-Hooghly, BCKV, and IFFCO with nano-Urea, nano-Zn and nano-Cu using RBD design with 10 treatments and 3 replications. Experimental results revealed that the highest tuber yield was obtained in T-7 (50% N+100% P & K+ 2 spray of nano-Urea), and that was followed by T-10 (50% N + 100% P & K + 50% Zn + 1 spray each of Nano-Urea, Zn and Cu) and T-8 (100% N-P-K + 50% Zn + 2 spray of Nano-Zn). The performance of nano fertilizers, Nano- Urea, was quite promising and economically viable as compared to the 100% recommended dose with commercial fertilizers (RDF).

Keywords: Nanotechnology; Plant Nutrition; Nano Urea; Potato

Introduction:

Potato is the third most important food crop after wheat and rice in India. It is an important crop in West Bengal. In potato production, West Bengal ranks 2nd, only after UP. Because potatoes are a heavy feeder crop, they require substantial amounts of fertilizer for growth, development, and production (Mishra,2018). Since nanotechnology is becoming recognized as one of the most promising strategies for increasing agricultural output in recent years, it has become vital to apply a variety of techniques in agriculture, including this one. Because potatoes are a heavy feeder crop, they require substantial amounts of fertilizer for growth, development, and production (Mishra,2018). Thus, nutrient management of Potato is very much essential for soil and environmental health without compromising the yield of the crop. Potato crop requires 180–240 kg N/ha fertilizers to produce a tuber yield of 35–45 t/ha. Ur=se efficiency of nitrogen in potato is only 40–50% and the remaining N is lost in the environment (Trehan and Singh, 2013). Thus, any alternative way to mitigate the loss and increase the use efficiency of the fertilizer is very important in terms of the sustainability of agriculture. Nano Urea, which has been authorized and listed in FCO, was introduced by IFFCO in India. They have also concluded its advantages over the traditional techniques after conducting a thorough investigation and trials.

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Objectives:

1) To find out the effect of nano fertilizers on the growth and yield of the Potato crop.
2) To observe the feasibility of reducing of dose of commercial prill Urea-fertilizer with the application of nano-N fertilizer.

Materials and Methods:

The field trial was conducted at Berui of Hooghly District of West Bengal during the winter (Rabi) season of 2019-20. The potato cultivar used in the experiment was Kufri Jyoti and medium size tubers (30-35g) were planted on 12-12-2019 at a spacing of 60 cm and at a depth of 5-7 cm and covered with soil. The soil of the experimental plot was sandy loam. Normal land preparation was done with plowing, followed by harrowing and planking or leveling. The experiment was laid out in RBD with 3 replications and 10 treatments. The treatments were as follows:

T-1 = Control (i.e., No Fertilizer)
T-2 = Control + 2 spray of tap water.
T-3 = 2 sprays of nano- N
T-4 = 2 sprays of nano-Zn
T-5 = 2 sprays of nano-Cu
T-6 =100% RDF (N, P, K & Zn @ 200- 150-150-15kg/ha)
T-7 = 50% N+100% P & K+ 2 spray of nano-N
T-8 = 100% NPK + 50% Zn+ 2 sprays of Nano-Zn
T-9 = 100% NPKZn + 2 spray of nano-Cu.
T-10 = 50% N + 100% P & K + 50% Zn + 1 spray each of nano-N, Zn, and Cu.

Nano fertilizers were applied twice, at 30 and 45 days after planting, except in T-10, where the 1st spray was done 30 days after planting with nano-N, followed by spraying of nano-Zn and nano-Cu at an interval of 15 days, which means the 3rd spray was done at 60 days after planting. Nano fertilizers were sprayed @ 4 ml/liter of water as per the treatment stated above.

Results and Discussion:

It has been observed that plant height, root length, and finally, tuber yield was recorded maximum in treatment T-7 (Table 1 & Figure 1) where the crop was fertilized with 2 sprays of Nano-N + recommended dose of P, K, and 50% of the recommended dose of N and the treatment was found best among all the treatments. A critical examination of data revealed that treatment T-7 with 50% of the full recommended dose of N (through urea) + 2 sprays of nano-N proved significantly superior to T-6 (100% RDF) in terms of tuber yield. The crop yield of treatment in T-8, fertilized with nano-Zn spraying along with 100% NPK + 50% Zn also gave a better yield than T-6 and the difference in yield was statistically significant. The treatment T-10 with 100% P and K, 50% N, 50% Zn and the single spray of each nano - N, nano - Zn, and nano - Cu recorded significantly higher yield than T-6 (100% RDF), however, the yield in T-10 was less than T-7 and T-7 was significantly better

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than T-10. The benefit-cost ratio (B:C) indicated that T-7 was better than the rest of the treatments. A study by **M.M. Abd El-Azeim et al** (2019) has found to produce more yield, and starch content and enhances nutrient use efficiency. According to a study by **DeRosa et al** controlling the nutrient release and providing crops with the exact amounts of nutrients in the right proportions, Nano fertilizers can increase yield while maintaining environmental safety.

To assess the efficacy of nano products on the yield of potato, data on some growth parameters were recorded and then analyzed statistically. The data revealed that T-7 produced a greater number of sub-branches per plant (Figure 1), as a result, crop canopy was also more in T-7, which indicated better photosynthesis in T-7 over other treatments. There was 12.3% more root length and 15.6% taller plant in T-7 which might have played an important role in the highest B: C Ratio of 2.1:1 and 6.9% incremental yield of tuber concerning 100% RDF in T- 6 treatment.

In crops like potato, root mass has a positive correlation with shoot mass and tuber bulking, and final tuber yield depends a lot on root length and root mass. It has been observed that Root length in T-7 was significantly more than T-2, T-3, and T-5 which could have played an important role in better nutrient uptake and consequent 6.9% incremental yield over RDF. Treatment T-10 with 50% of the recommended dose of N & Zn and 100% P & K fertilizers and one spray of nano-N at 30 days after planting, followed by 2nd spray of nano-Zn at 45 days after planting and 3rd spray of nano-Cu at 60 days after planting recorded 9.37% more plant height, 6.85 % more root length with marginal 3.5% yield increase concerning 100% RDF (T- 6). In treatments T-7 and T-10, the size of the last (terminal) leaf, and spread of roots have also been found better than that observed in T-6. Further, it may be worth mentioning here that the crop maturity was advanced in T7 by 8 days over T-6. In a 2013 study by Raliya and Tarafdar, it was shown that zinc oxide, Nano Particles enhanced the activity of the enzyme's acid phosphatase, alkaline phosphatase, and phytase in the rhizosphere of a cluster bean plant.

The 10-point experiment (with 10 treatments) on potatoes, conducted at Berui Village, Hoogly (W.B.), showed that application of nano-N @4ml/Litre with 2 sprays at 30 & 45 days after planting has an important bearing in sustaining the yield of potato with 50% cut in the recommended dose of fertilizer N (urea), and at the most top dressing of urea (i.e., 50% of the recommended dose) could safely be omitted with 2 sprays of nano-N. Nano-Zn spray with a 50% recommended dose of Zn has also been found satisfactory to sustain yield. However, the role of nano-Cu in potato yield is not conspicuous (clear from the one-year experiment) and needs further experiments to reach any decision. H W A Al-juthery et al. in 2018 found that the combination treatment with Nanofertilizers has come up with better production with enhanced crude protein, and starch content of the produce.

Table 1: Effect of Nano Fertilizer on growth and Yield of the Potato crop

TREATMENT	Plant Height (cm)	Root length (cm)	Main stem girth (cm)	Tuber Yield (kg/ha)	B:C RATIO

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T- 1	40.8	7.0	3.2	8330.0	0.75:1
T- 2	42.4	6.8	3.4	8540.0	0.75:1
T- 3	41.6	6.6	3.1	9187.5	0.80:1
T- 4	43.2	7.1	3.3	8662.5	0.75:1
T- 5	44.8	6.7	3.1	8575.0	0.74:1
T- 6	51.2	7.3	4.3	25795	2.01:1
T-7	59.2	8.2	4.1	27580	2.10:1
T- 8	56.8	7.9	4.4	26635	2.04:1
T- 9	54.4	7.6	4.3	26005	1.95:1
T-10	56.0	7.8	3.8	26705	1.99:1
SEm (±)	**1.09**	**043**	**0.20**	**47.58**	-
CD at 0.05	**3.24**	**1.28**	**0.59**	**141.36**	-

Branch/plant

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No. of main branch/plant No. of subbranch/plant

Figure 1: Effect of Treatments on Growth parameters of Potato

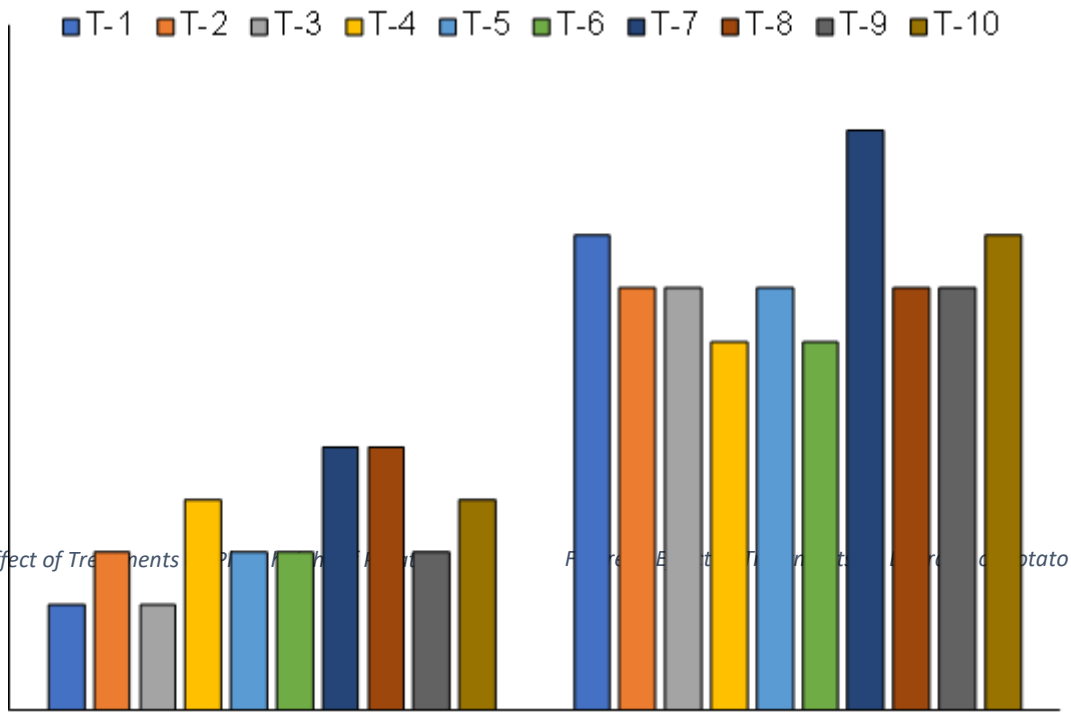
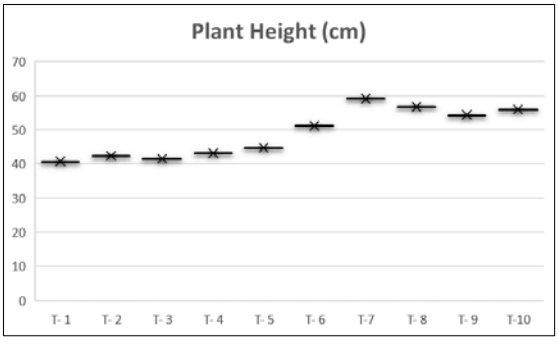
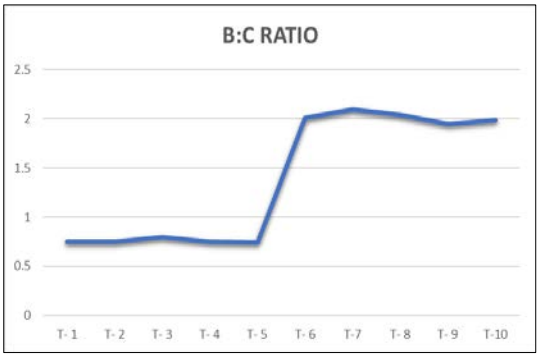


Figure 2: Effect of Tre[illegible] Potato





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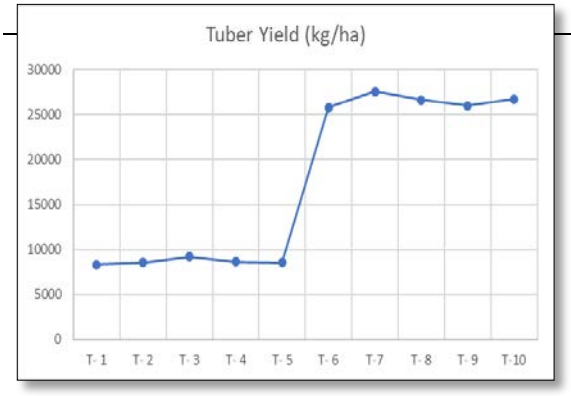

Figure 4: Effect of Treatments on Yield of Potato

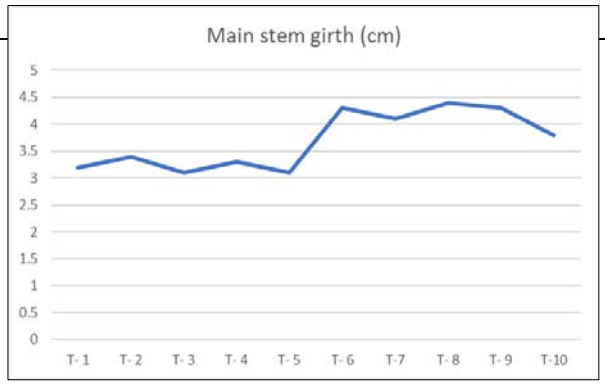

Figure 5. Effect of Treatments on main stem girth of Potato

Conclusion:

It may be concluded from the present study that a 50% reduction of recommended N fertilizer dose through conventional prill urea, or in other words substitution of recommended commercial N fertilizer (urea), with Nano Urea (N) in liquid form is very much possible which has not only contributed 6.9%yield increase in the study but also at the same time has given additional income to farmers to the tune of Rs 17800/-per ha(7100/-per acre). Local Farmers in adjoining villages of Berui Cooperative were very much impressed with the performance of Nano Urea and transmitted new hope and aspirations in potato cultivation. The application of nano-fertilizer may be considered a sustainable management practice since it will help to reduce the cost of cultivation apart from benefitting soil health.

Competing interests:

The authors have declared that no competing interests exist.

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