Effect of integrated nutrient management on tuber yield of potato under Meghalaya agro-ecological condition

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Abstract
A field experiment was conducted during the summer season of the year 2016-2017 and 2017-2018 at Central Potato Research Station, Shillong, Meghalaya to find out the effect of integrated nutrient management in potato (Var. Kufri Jyoti) under Meghalaya agro-ecological condition. The experiment was laid out in randomized block design with nine treatment and replicated thrice. The nine integrated nutrient treatments are 100% RDF, 25% RDF + 75% RDN-FYM, 75% RDF + 25% RDN-FYM, 25% RDF + 75% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria, 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria, 100% RDN-FYM, Boron, Azotobacter + PSB + Potash mobilizing bacteria and control. Among the various treatments it was observed that highest yield was obtained in the treatment 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (20.06 t/ha) followed by 75% RDF + 25% RDN-FYM (17.50 t/ha) and 100 % RDF (16.90 t/ha) and lowest yield was obtained in the treatment of control (4.83 t/ha) on the basis two years pooled data. The highest total number of tuber per hectare was obtained in the treatment 75% RDF + 25% RDN-FYM (763425.92 /ha) followed by 75% RDF + 25% RDN-FYM (731018.51 /ha) and lowest total number of tuber per hectare was obtained in the treatment of control (306944.44 /ha) on the basis two years pooled data.

Keywords: Potato, INM, FYM, PSB, Potash mobilizing bacteria, yield

Introduction
Potato (Solanum tuberosum L.) belongs to family Solanaceae, is one of the most important tuber vegetable crop grown in India as well as around the world. India is the second largest producer of potato in the world after China. Potato is one of the most important tuber crop grown by the farmers of whole Northeast India. Using only chemical based fertilizer is not suitable for long run sustain agriculture and we can overcome this problem by using integrated plant nutrient approach consist of a combination of chemical fertilizers, organic manures, bio-fertilizers and micronutrient are play important role to sustain crop production, improve soil health and soil bio-diversity and preserve the healthy soil for future crop production. Using organic manures, bio-fertilizer increase the beneficial microorganism in the soil which help for better crop yield. Continuous use of only chemical fertilizers can destroy the soil texture and structure as well as decrease the organic matter content from the soil. Biofertilizers is an important input in organic agriculture play a tremendous role for maintaining long run good soil health. Chemical fertilizer dose along with organic fertilizers specially FYM, Azotobacter and crop residues increase the productivity of rice-potato-okra cropping sequence (Benerjee et al. 2016) [1]. Application of Biofertilizers along with organic and inorganic fertilizers has positive and significant influence on yield and its attributes (Sethy BK et al., 2019) [3]. Application of phosphate solubilizing bacteria as inoculants simultaneously increases P uptake by the plant and crop yield (Vikash Kumar et al. 2020 and Rodriguez et al., 1999) [5, 2]. Integrated use of inorganic and organic sources of nutrients significantly improved the yield of potato (Sumati Narayan et al. 2013) [4].
Materials and Methods

A field experiment was conducted during the summer season of the year 2016-2017 and 2017-2018 at Central Potato Research Station, Shillong, Meghalaya. Geographically experimental field are located at 25°54' N, 91°38' E and 1770 m above mean sea-level. The experiment was laid out in randomized block design with nine treatment and replicated thrice. The nine integrated nutrient treatments are T1- 100% RDF, T2- 25% RDF + 75% RDN-FYM, T3- 75% RDF + 25% RDN-FYM, T4- 25% RDF + 75% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria, T5- 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria, T6- 100% RDN-FYM, T7- Boron, T8- Azotobacter + PSB + Potash mobilizing bacteria and T9-Control (Without using any fertilizer input). Kufri Jyoti was the potato variety used in this research programme. The recommended dose of N, P, and K was taken as 140, 120 and 60 kg/ha for the crop. Nitrogen, phosphorus and potassium was applied in the form of urea, SSP and MOP respectively. Biofertilizers (Azotobacter + PSB + Potash mobilizing bacteria) was applied through seed inoculation at the time of sowing. Ridges and furrow planting method is followed. Earthing up and weeding was done after 50 days of planting. Plant protection measures were used as per standard recommendations in this region for potato crop to control diseases and insects at the right time. All the statistical analysis was done using OPSTAT statistical software.

Results and Discussion

Effect of INM on total number of tuber: The results revealed that among the various treatments the highest total number of tuber per hectare was obtained in the treatment 75% RDF + 25% RDN-FYM (76425.92 /ha) followed by 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (731018.51 /ha) and lowest total number of tuber per hectare was obtained in the treatment of control (306944.44 /ha) on the basis two years pooled data (2016-2017 and 2017-2018). The data revealed that during the 1st year (2016-2017) of study the highest total number of tuber per hectare was obtained in the treatment 75% RDF + 25% RDN-FYM (759259.25/ha) followed by 100% RDN-FYM (729166.66 /ha) lowest total number of tuber per hectare was obtained in the treatment of Boron (311111.11/ha). During the 2nd year (2017-2018) of study the highest total number of tuber per hectare was obtained in the treatment 75% RDF + 25% RDN-FYM (767592.59 /ha) followed by 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (736574.07/ha) and lowest total number of tuber per hectare was obtained in the treatment of control (293518.51 /ha). Sumati Narayan et al. (2013) [4]. Reported that integrated nutrient management practices significantly influenced the number of different grades of tuber.

Table 1: Effect of Integrated nutrient management on Total numbers of tuber and Total tuber yield of potato (Pooled data of two years 2016- 2017 & 2017-2018)

| Treatment | Total number of tuber/ha | Total tuber yield (t/ha) |
|-----------|--------------------------|-------------------------|
| T1        | 564120.37                | 16.90                   |
| T2        | 503472.22                | 14.96                   |
| T3        | 763425.92                | 17.50                   |
| T4        | 610416.66                | 16.13                   |
| T5        | 731018.51                | 20.06                   |
| T6        | 730787.03                | 16.26                   |
| T7        | 327777.77               | 6.72                    |
| T8        | 359490.74                | 10.23                   |
| T9        | 306944.44               | 4.83                    |
| S.Em+     | 29860.83               | 0.74                    |
| CD (P=0.05)| 90293.59              | 2.24                    |

Table 2: Effect of Integrated nutrient management on total number of tubers of potato for the year 2016-2017

| Treatment | Number of tubers / ha (2016-17) |
|-----------|---------------------------------|
| T1        | 307870.37                      |
| T2        | 289351.85                      |
| T3        | 493055.55                      |
| T4        | 388888.88                      |
| T5        | 494097.40                      |
| T6        | 42034.98                       |
| T7        | 233796.29                      |
| T8        | 37796.29                       |
| T9        | 42034.98                       |
| S.Em+     | 42034.98                       |
| CD (P=0.05)| 127105.93                    |

Table 3: Effect of Integrated nutrient management on total number of tubers of potato for the year 2017-2018

| Treatment | Number of tubers / ha (2017-18) |
|-----------|---------------------------------|
| T1        | 308796.29                      |
| T2        | 290277.77                      |
| T3        | 494097.40                      |
| T4        | 377314.81                      |
Effect of INM on tuber yield

The results revealed that among the various treatments the highest yield was obtained in the treatment 75% RDF + 25% RDN + Azotobacter + PSB + Potash mobilizing bacteria (19.23 t/ha) followed by 75% RDF + 25% RDN + Boron + Azotobacter + PSB + Potash mobilizing bacteria (20.90 t/ha) and lowest yield was obtained in the treatment of control (4.25 t/ha). During the 2nd year (2017-2018) of study the highest yield was obtained in the treatment 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (17.94 t/ha) followed by 75% RDF + 25% RDN-FYM + Azotobacter + PSB + Potash mobilizing bacteria (20.06 t/ha) and lowest yield was obtained in the treatment of control (4.51 t/ha). During the 2nd year (2017-2018) of study the highest yield was obtained in the treatment 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (19.23 t/ha) followed by 75% RDF + 25% RDN-FYM (17.06 t/ha) and lowest yield was obtained in the treatment of control (5.41 t/ha). During the 2nd year (2017-2018) of study the highest yield was obtained in the treatment 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria (20.06 t/ha) and lowest yield was obtained in the treatment of control (4.25 t/ha). Sumati Narayan et al. (2013) [4]. Reported that various treatment of organic and inorganic nutrient combinations had significant effect on yield and related parameters. The similar result also found by Vikash Kumar et al. (2020) [3].

Table 4: Effect of Integrated nutrient management on tuber yield of potato for the year 2016-2017

| Treatment | Tuber yield (t/ha) (2016-17) |
|-----------|-------------------------------|
|           | 0-25g | 25-50g | 50-75g | >75g | Total tuber yield (t/ha) |
| T1        | 3.56  | 5.45   | 5.04   | 2.62 | 16.68                   |
| T2        | 4.44  | 5.25   | 4.32   | 0.65 | 14.67                   |
| T3        | 6.31  | 6.73   | 3.64   | 0.36 | 17.06                   |
| T4        | 5.57  | 5.63   | 3.86   | 0.88 | 15.95                   |
| T5        | 5.76  | 8.15   | 4.75   | 0.55 | 19.23                   |
| T6        | 7.15  | 6.67   | 2.01   | 0.39 | 16.24                   |
| T7        | 3.22  | 2.16   | 0.62   | 0.00 | 6.01                    |
| T8        | 2.62  | 2.52   | 2.19   | 0.99 | 8.33                    |
| T9        | 2.93  | 2.12   | 0.35   | 0.00 | 5.41                    |
| S.Em+     | 0.41  | 0.56   | 0.57   | 0.46 | 1.93                    |
| CD (P=0.05)| 1.26  | 1.70   | 1.74   | 1.40 | 3.13                    |

Table 5: Effect of Integrated nutrient management on tuber yield of potato for the year 2017-2018

| Treatment | Tuber yield (t/ha) (2017-18) |
|-----------|-------------------------------|
|           | 0-25g | 25-50g | 50-75g | >75g | Total tuber yield (t/ha) |
| T1        | 3.58  | 5.47   | 5.17   | 2.90 | 17.13                   |
| T2        | 4.49  | 5.16   | 4.69   | 0.90 | 15.26                   |
| T3        | 6.44  | 6.79   | 4.22   | 0.48 | 17.94                   |
| T4        | 5.54  | 5.77   | 4.11   | 0.88 | 16.31                   |
| T5        | 6.23  | 8.76   | 5.13   | 0.77 | 20.97                   |
| T6        | 6.90  | 6.69   | 2.20   | 0.48 | 16.28                   |
| T7        | 3.44  | 3.25   | 0.71   | 0.03 | 7.44                    |
| T8        | 4.16  | 3.28   | 3.02   | 1.67 | 12.14                   |
| T9        | 2.29  | 1.79   | 0.16   | 0.00 | 4.25                    |
| S.Em+     | 0.13  | 0.13   | 0.33   | 0.22 | 0.50                    |
| CD (P=0.05)| 0.41  | 0.40   | 1.00   | 0.67 | 1.54                    |

Conclusion

This study indicated that application of organic manure and bio-fertilizers can minimize the only use of chemical fertilizers. This study also indicated that application of 75% RDF + 25% RDN-FYM + Boron + Azotobacter + PSB + Potash mobilizing bacteria can give highest tuber yield (20.06 t/ha) on the basis two years pooled data.

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