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Different NPK combinations under four fertility gradient soil showed the differential disease reaction. Maximum disease incidence of stem rot was recorded under low, moderate, medium and high fertility gradient soil in $N_{20}P_{40}K_{40}$, $N_{20}P_{40}K_{40}$, $N_{20}P_{60}K_{40}$, and $N_{20}P_{60}K_{20}$ combinations respectively and minimum in $N_{40}P_{20}K_{40}$, $N_{40}P_{20}K_{40}$, $N_{40}P_{20}K_{40}$, and $N_{40}P_{20}K_{20}$ combinations respectively. High fertility gradient soil showed maximum disease incidence as compared to low moderate and medium fertility gradient soil. Every date of observation showed that with increasing fertility gradient of soil there was a significant increase in disease incidence irrespective of different NPK combinations and minimum disease incidence was observed in low fertility gradient soil. Disease incidence was increased with increase in age of plants. Different NPK combinations showed different growth of disease incidence like exponential increase and few quadrative. Kernel yield was also different in different NPK combination under different fertility gradient soil condition. The maximum kernel yield in different fertility gradient soil were $S_1N_{40}P_{40}K_{20}$ (26.66 q ha$^{-1}$), $S_2$ $N_{40}P_{20}K_{20}$ (27.0 q ha$^{-1}$), $S_3$ ($N_{40}P_{40}K_{40}$ (29.0 q ha$^{-1}$) and $S_4$ $N_{20}P_{20}K_{40}$ (32.0 q ha$^{-1}$).

**Key words:** Disease severity, groundnut, Sclerotium rot, soil fertility status

## INTRODUCTION

Groundnut (*Arochis hypogaea* Linn.) is one of the most important oilseed crop grown throughout the tropics and subtropics lying between 40 $^0$N and 40 $^0$S of the equator. Groundnut is prone to attack by many fungal diseases. Among which, stem rot caused by *Sclerotium rolfsii* is a potential threat to groundnut production and is of considerable economic significance. There are various biotic and abiotic factors affecting on the disease incidence as well its yield attributes. So, infectious plant diseases are results of a combination of host, pathogen, environment and nutrition factor over time. Among these, nutritional factor of plant plays a major role, in plant disease, which affect the rate of growth and state of readiness of plants to defend themselves against pathogen attack. A disease can be reduced by application of different nutrition, but the severity of many diseases is reduced by specific levels of fertility gradient arranged by soil treatment with different NPK and organic matter like FYM before cultivation (Mahapatra *et al*. 2012). So, knowledge of host nutrition in relation to disease development provides a basis for modifying current agriculture practices to reduce disease severity and it should be considered as important cultural weapon in our arsenal for controlling disease in an integrated crop production system. The plant disease can be eliminated by judicious combination of nutrient level but the severity of most plant disease can be greatly decreased by specific nutrient level. The knowledge of plant nutrition with the relationship of plant disease provides a basis for modifying current agricultural practices to reduce disease severity in integrated crop production management (Yampi, 2007).

As the demand for oilseed crop production in-

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creased, the farmers began to apply fertilizers staggeredly in order to increase yield in different locations without knowing the fertility status of the soil. But this increase use of fertilizers in different regions predisposed the cultivated crop towards infection by various diseases in low to severe form. Management of any disease is dependent on developing management strategies based on spread of the pathogen. But no attention has been given on nutritional status of the soil which has also an important factor for disease incidence and spread. For viable and accurate management hardly any studies on these aspects have been conducted so far in India as well as in West Bengal. Keeping in mind the studies were conducted on different NPK combinations against stem rot of groundnut to find out the incidence and spread under four fertility gradient soil conditions. The kernel yield was also collected to find out the actual doses of fertilizers required under four fertility gradient soil to harvest more yield with less disease.

## MATERIALS AND METHODS

The experiment was laid out at Regional Research Station, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, Nadia,West Bengal during the *pre-kharif* season for two consecutive years 2013 to 2014 to study the effect of different fertility gradient of soil. The field consisted of 4 strips each divided into four main equal plots and each of the main plots were divided into 16 sub-plots covering a total area of 25 sq.m (5m X 5m) and gross plot area under the 64 plots in 4 fertility gradient strips were 2000sq. m. Each of the plots was separated by one meter channel. Soil samples collected from 15 cm depth from 4 plots under each treatment were analyzed for pH, organic carbon (%), $KMnO_{-4}$ – N, Olsen – O and $NH_4OAc$ – K before land preparation and available mean nutrients of the two years data were as low (S1)- pH, 6.3; N, 277.3; P, 9.5; K, 90.3 kg ha-1; in medium (S2)-Ph,6.2; N, 276.4; P, 12.6; K, 123.5 kg ha-1; in moderate (S3)- Ph, 6.4; N, 275.4; P, 16.2; K, 163.3 kg ha-1; and in high (S4)- pH, 6.3; N, 290.1; P, 26.3; K, 243.3 kg ha-1. The experiment was conducted in a split plot design composed of 13 different treatments [**T1,**$N_{40}P_{20}K_{40}$; **T2,**$N_{40}P_{60}K_{20}$;**T3**, N-$_{20}P_{40}K_{20}$;**T4,**$N_{20}P_{60}K_{40}$;**T5**, N-$_{40}P_{40}K_{20}$;**T6,** $N_{20}P_{40}K_4$;**T7,** $N_{40}P_{20}K_{20}$; **T8,**$N_{40}P_{60}K_{40}$;**T9,** $N_{40}P_{40}K_{40}$;**T10,** N-$_{20}P_{60}K_{20}$ ;**T11,** $N_{20}P_{20}K_{20}$ ;**T12,** N-$_{20}P_{20}K_{40}$ ;**T13,** N-$_0P_0K_0$] with three replicates in a split plot design. These 12 different NPK combinations were applied at the final land preparation keeping of an untreated control. Groundnut seeds were planted on 25th september, 2013 and 15th September 2014 with the inter row spacing maintained at 60 cmX10 cm. All experimental plots were uniformly feritilized and total NPK were applied as the basal dose during the final land preparation. All other agronomical practices followed for this experiment was without any fungicides for determining the severity of *Sclerotium* rot of groundnut.The natural incidence of the disease *Sclerotium rot* was recorded at 15 days intervals commencing from the first appearance of the disease. Per cent disease incidence was calculated as per Datta *et al.* (2011).The groundnut rows were harvested on 20th to 25th December, 2013 and 20th to 25th December, 2014 in two consecutive years. The fresh weight of groundnut kernel per replication per plot was taken in kg per plot then converted to quintal per hectare.The experimental results were statistically interpreted through calculation of Analysis of variance by a standard method (Yampi, 2007) and the significance of different treatments was tested by Error mean square by Fisher and Snedicos's 'F' test at probability level 0.05. For determination of critical difference (CD) at 5% level of significant Fisher's and Yate's tables were consulted.

## RESULTS AND DISCUSSION

### *Sclerotium rot incidence*

Disease incidence showed that with increased in age of plant the disease incidence was increased irrespective of fertility gradient soil and NPK combinations. In low fertility gradient (Strip-I) soil disease incidence was minimum and increased significantly with increase in fertility gradient soil and maximum in high fertility gradient soil condition. Different NPK combinations also showed different disease incidence in different fertility gradient soil condition. In low fertility gradient soil in the year 2013, the minimum disease incidence was recorded in $N_{40}P_{20}K_{40}$ (20.0%) statistically at par with $N_{20}P_{60}K_{40}$ (20.0%), $N_{40}P_{20}K_{40}$ (20.0%) treatment combinations. Whereas, the maximum disease incidence was noticed in $N_{40}P_{40}K_{40}$ (23.0%) statistically at par with $N_{20}P_{20}K_{40}$ (23.0%) combinations. The medium disease incidence was observed in $N_{20}P_{40}K_{20}$ (22.0%) statistically at par with $N_{20}P_{40}K_{40}$ (22.0%), $N_{40}P_{60}K_{40}$ (22.0%), $N_{20}P_{20}K_{20}$ (22.0%) treatment combinations. In the year 2014, the maximum disease incidence

**Table 1 :** Different NPK combinations on Sclerotium rot of groundnut (%) on different fertility gradient soil

| Treatment | Strip-I | | | Strip-II | | | Strip-III | | | Strip-IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Disease Incidence | | | Disease Incidence | | | Disease Incidence | | | Disease Incidence | | |
| | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled |
| $N_{40}P_{20}K_{40}$ | 20.0 | 21.0 | 20.5 | 23.0 | 23.0 | 23.0 | 27.0 | 26.0 | 26.5 | 30.0 | 32.0 | 31.0 |
| | (26.6) | (27.3) | (26.9) | (28.6) | (28.6) | (28.6) | (31.3) | (30.6) | (30.9) | (33.2) | (34.4) | (33.8) |
| $N_{40}P_{60}K_{20}$ | 21.0 | 22.0 | 21.5 | 24.0 | 24.0 | 24.0 | 28.0 | 27.0 | 27.5 | 31.0 | 33.0 | 32.0 |
| | (27.3) | (27.9) | (27.6) | (29.3) | (29.3) | (29.3) | (31.9) | (31.3) | (31.6) | (33.8) | (35.0) | (34.4) |
| $N_{20}P_{40}K_{20}$ | 22.0 | 20.0 | 21.0 | 25.0 | 23.0 | 24.0 | 29.0 | 28.0 | 28.5 | 32.0 | 34.0 | 33.0 |
| | (27.4) | (26.6) | (27.2) | (29.9) | (28.6) | (29.3) | (32.6) | (31.9) | (32.3) | (34.4) | (35.7) | (35.0) |
| $N_{20}P_{60}K_{40}$ | 20.0 | 21.0 | 20.5 | 24.0 | 24.0 | 24.0 | 30.0 | 29.0 | 29.5 | 33.0 | 31.0 | 32.0 |
| | (26.6) | (27.3) | (26.9) | (29.3) | (29.3) | (29.3) | (33.2) | (32.6) | (32.9) | (35.0) | (33.8) | (34.4) |
| $N_{40}P_{40}K_{20}$ | 21.0 | 22.0 | 21.5 | 25.0 | 25.0 | 25.0 | 30.0 | 27.0 | 28.5 | 33.0 | 32.0 | 32.5 |
| | (27.3) | (27.9) | (27.6) | (29.9) | (29.9) | (29.9) | (33.2) | (31.3) | (32.2) | (35.0) | (34.4) | (34.7) |
| $N_{20}P_{40}K_{40}$ | 22.0 | 23.0 | 22.5 | 26.0 | 25.0 | 25.5 | 28.0 | 27.0 | 27.5 | 34.0 | 33.0 | 33.5 |
| | (27.9) | (28.6) | (28.3) | (30.6) | (29.9) | (30.3) | (31.9) | (31.3) | (31.6) | (35.6) | (35.0) | (35.3) |
| $N_{40}P_{20}K_{20}$ | 20.0 | 22.0 | 21.0 | 23.0 | 24.0 | 23.5 | 27.0 | 28.0 | 27.5 | 32.0 | 32.0 | 32.0 |
| | (26.6) | (27.9) | (27.3) | (28.7) | (29.3) | (28.9) | (31.3) | (31.9) | (31.6) | (34.4) | (34.4) | (34.4) |
| $N_{40}P_{60}K_{40}$ | 22.0 | 20.0 | 21.0 | 24.0 | 23.0 | 23.5 | 28.0 | 28.0 | 28.0 | 31.0 | 33.0 | 32.0 |
| | (27.9) | (26.6) | (27.2) | (29.3) | (28.6) | (28.9) | (31.9) | (31.9) | (31.9) | (33.8) | (35.0) | (34.4) |
| $N_{40}P_{40}K_{40}$ | 23.0 | 21.0 | 22.0 | 25.0 | 22.0 | 23.5 | 29.0 | 29.0 | 29.0 | 33.0 | 34.0 | 33.5 |
| | (28.6) | (27.3) | (27.9) | (24.9) | (27.09) | (28.9) | (32.6) | (32.6) | (32.6) | (35.0) | (35.7) | (35.3) |
| $N_{20}P_{60}K_{20}$ | 20.0 | 21.0 | 21.0 | 26.0 | 25.0 | 25.5 | 29.0 | 29.0 | 29.0 | 34.0 | 35.0 | 34.5 |
| | (27.3) | (27.3) | (27.3) | (30.6) | (29.9) | (30.3) | (32.6) | (32.6) | (32.6) | (35.7) | (36.3) | (35.9) |
| $N_{20}P_{20}K_{20}$ | 22.0 | 22.0 | 22.0 | 26.0 | 25.0 | 25.5 | 29.0 | 26.0 | 27.5 | 33.0 | 33.0 | 33.0 |
| | (27.9) | (27.9) | (27.9) | (30.6) | (29.9) | (30.3) | (32.6) | (30.6) | (31.6) | (35.0) | (35.1) | (35.0 |
| $N_{20}P_{20}K_{40}$ | 23.0 | 20.0 | 21.5 | 25.0 | 24.0 | 24.5 | 30.0 | 27.0 | 28.5 | 34.0 | 34.0 | 34.0 |
| | (28.6) | (26.5) | (27.6) | (29.9) | (29.3) | (29.7) | (33.2) | (31.3) | (32.2) | (35.7) | (35.7) | (35.7) |
| $N_0P_0K_0$ | 26.0 | 23.0 | 24.5 | 28.0 | 26.0 | 27.0 | 30.0 | 30.0 | 30.0 | 35.0 | 36.0 | 35.5 |
| | (30.6) | (28.6) | (29.6) | (31.9 | (30.6) | (31.3) | (33.2) | (33.2) | (33.2) | (36.3) | (36.9) | (36.6) |
| | Year (Y) | Strip (S) | Y x S | | Treatment (T) | Y x T | | S x T | | Y x S x T | | CV% |
| SEm (±) | 0.092 | 0.131 | 0.185 | | 0.193 | 0.274 | | 0.387 | | 0.547 | | 3.05 |
| $CD_{p=0.05}$ | 0.285 | 0.402 | 0.569 | | 0.535 | 0.758 | | 1.073 | | 1.517 | | |

was recorded in $N_{20}P_{40}K_{40}$ (23.0%) statistically at par with untreated control ($N_0P_0K_0$). The minimum disease incidence was noticed in $N_{20}P_{40}K_{20}$ (20.0%) statistically at par with $N_{40}P_{60}K_{40}$ (20.0%) and $N_{20}P_{20}K_{40}$ (20.0%) treatment combinations. The two years pooled mean showed the minimum disease incidence in $N_{40}P_{20}K_{40}$ (20.5%) statistically at par with $N_{20}P_{60}K_{40}$ (20.5%), $N_{40}P_{20}K_{20}$ (21.0%), $N_{40}P_{60}K_{40}$

(21.0%), $N_{20}P_{40}K_{20}$ (21.0%) and $N_{20}P_{60}K_{20}$ (21.0%) treatment combinations. The maximum disease incidence was noticed in $N_{20}P_{40}K_{40}$ (22.5%) statistically at par with $N_{40}P_{40}K_{40}$ (22.0%) and $N_{20}P_{20}K_{20}$ (22.0%) treatment combinations. No significant difference in disease incidence was recorded in $N_{40}P_{60}K_{20}$, $N_{20}P_{40}K_{20}$, $N_{40}P_{40}K_{20}$, $N_{20}P_{20}K_{40}$ and $N_{20}P_{60}K_{20}$ treatment combinations. In low fertility gradient soil it was observed that with increase in potassium (K) disease incidence was reduced and with increase in both nitrogen and potassium disease severity was also reduced irrespective of phosphorus application. All the NPK combination reduced the disease incidence significantly as compared to untreated control (Table 1).

In moderate fertility gradient soil (Strip-II) the disease incidence was increased significantly as compared to low fertility gradient soil. This situation was observed irrespective of different NPK combinations. The two years also showed the difference in disease incidence and their difference was statistically significant. In the year 2013, the minimum disease incidence was observed in $N_{40}P_{20}K_{40}$ (23.0%) statistically at par with $N_{40}P_{20}K_{20}$ (23.0%) treatment combination. The maximum disease incidence was located in $N_{20}P_{40}K_{40}$ (26.0%) statistically at par with $N_{20}P_{60}K_{20}$ (26.0%) and $N_{20}P_{20}K_{20}$ (26.0%) treatment combinations. In the year 2014, the maximum disease incidence was observed in $N_{20}P_{40}K_{40}$ (25.0%) statistically at par with $N_{20}P_{20}K_{20}$ (25.0%), $N_{20}P_{60}K_{20}$ (25.0%) and $N_{40}P_{40}K_{20}$ (25.0%) treatment combinations. The minimum disease incidence was noted in $N_{40}P_{20}K_{40}$ (23.0%) statistically at par with $N_{20}P_{40}K_{20}$ (23.0%), $N_{40}P_{60}K_{40}$ (23.0%). The two years pooled mean showed the maximum disease incidence in $N_{20}P_{40}K_{40}$ (25.5%) statistically at par with $N_{20}P_{60}K_{20}$ (25.5%), $N_{20}P_{20}K_{20}$ (25.5%) and $N_{20}P_{40}K_{40}$ (25.0%) treatment combinations. The minimum disease incidence was recorded in $N_{40}P_{20}K_{40}$ (23.0%) statistically at par with $N_{40}P_{20}K_{20}$ (23.5%), $N_{40}P_{60}K_{40}$ (23.5%) and $N_{40}P_{40}K_{40}$ (23.5%) treatment combinations. The other treatment combinations showed medium level of disease incidence (24.0% to 24.5%) and their differences were not statistically significant. The moderate fertility gradient soil showed that with increase in N and K there was a significant decrease in disease incidence irrespective of phosphorus level (Table 1).

In medium fertility gradient soil (Strip-III) the disease incidence increased significantly as compared to moderate fertility gradient soil irrespective of different NPK combinations. Though, all the NPK combination reduced the disease incidence significantly in comparison to untreated control. Two years disease incidence in different NPK combinations showed differential reaction and their differences were statistically significant with a few exception. In the year 2013 the maximum disease incidence was noticed in $N_{20}P_{60}K_{40}$ (30.0%) statistically at par with $N_{40}P_{40}K_{20}$ (30.0%), $N_{20}P_{20}K_{40}$ (30.0%) and untreated control ($N_0P_0K_0$). The minimum disease incidence was recorded in $N_{40}P_{20}K_{40}$ (27.0%) statistically at par with $N_{40}P_{20}K_{20}$ (27.0%) In the year 2014, the minimum disease incidence was observed in $N_{40}P_{20}K_{40}$ (26.0%) statistically at par with $N_{20}P_{20}K_{20}$ (26.0%). The maximum disease incidence was noted in $N_{20}P_{60}K_{20}$ (29.0%) statistically at par with $N_{40}P_{40}K_{40}$ (29.0%) and $N_{20}P_{60}K_{40}$ (29.0%) treatment combinations. The other NPK combinations showed medium level of disease incidence and their differences in disease incidence were statistically significant except few exceptions. The two years pooled mean showed the minimum disease incidence in $N_{40}P_{20}K_{40}$ (26.5%) followed by $N_{40}P_{60}K_{20}$ (27.5%), $N_{20}P_{40}K_{40}$ (27.5%), $N_{40}P_{20}K_{20}$ (27.5%) and $N_{20}P_{20}K_{20}$ (27.5%) treatment combinations and their difference was statistically significant except later four treatment combinations. The maximum disease incidence was observed in $N_{20}P_{60}K_{40}$ (29.5%) statistically at par with $N_{40}P_{40}K_{40}$ (29.0%), $N_{20}P_{60}K_{20}$ (29.0%) treatment combinations. No significant difference in disease incidence was observed among the treatments like $N_{20}P_{40}K_{20}$, $N_{40}P_{40}K_{20}$, $N_{20}P_{20}K_{40}$ and $N_{40}P_{60}K_{40}$ though they exhibited medium level of disease incidence and significantly minimum as compared to untreated control ($N_0P_0K_0$). It was also observed that $N_{40}P_{20}K_{40}$ exhibited minimum level of disease incidence as observed in earlier two fertility gradient soil (Table 1).

In high fertility gradient soil (Strip-IV) the disease incidence was more pronounced and significantly increased as compared to other three fertility gradient soils. Similar results were also recorded in different NPK combinations. Two years disease incidence results in different NPK combinations were also significantly increased and their difference was statistically significant. In the year 2013, the maximum disease incidence was noticed in $N_{20}P_{60}K_{20}$ (34.0%) statistically at par with $N_{20}P_{20}K_{40}$ (34.0%) and $N_{20}P_{40}K_{40}$ (34.0%) treatment combinations. The minimum disease incidence was recorded $N_{40}P_{20}K_{40}$ (30.0%) followed by $N_{40}P_{60}K_{20}$

**Table 2 :** Kernel yield (q ha-1) of groundnut in different NPK combination on different fertility gradient soil

| Treatments | 2013 | | 2014 | | Two years | |
|---|---|---|---|---|---|---|
| | Kernel yield (q ha-1) | Percent increase (+) or decrease (-) over control | Kernel yield (q. h-1) | Percent increase (+) or decrease (-) over control | Kernel yield (q ha-1) | Percent increase (+) or decrease (-) over control |
| $S_1$ $N_{40}P_{20}K_{40}$ | 24.8 | 1.62 | 24 | -14.13 | 24.4 | -6.25 |
| $S_1N_{40}P_{60}K_{20}$ | 26 | 6.88 | 24 | -14.05 | 25 | -3.58 |
| $S_1N_{20}P_{40}K_{20}$ | 26 | 6.69 | 26 | -6.6 | 26 | 0.04 |
| $S_1N_{20}P_{60}K_{40}$ | 25.2 | 3.32 | 22 | -21.76 | 23.6 | -9.22 |
| $S_1N_{40}P_{40}K_{20}$ | 24 | -1.29 | 29.33 | 4.62 | 26.63 | 1.66 |
| $S_1N_{20}P_{40}K_{40}$ | 26 | 6.82 | 20 | -28.51 | 23 | -10.84 |
| $S_1N_{40}P_{20}K_{20}$ | 26 | 6.58 | 26 | -7 | 26 | -0.21 |
| $S_1N_{40}P_{60}K_{40}$ | 26 | 6.32 | 26 | -7.63 | 26 | - 0.65 |
| $S_1N_{40}P_{40}K_{40}$ | 26.8 | 9.96 | 28 | -0.26 | 27.4 | 4.85 |
| $S_1N_{20}P_{60}K_{20}$ | 25.6 | 5.07 | 24 | -14.29 | 24.8 | - 4.61 |
| $S_1N_{20}P_{20}K_{20}$ | 25.33 | 3.93 | 24 | -14.27 | 24.66 | - 5.17 |
| $S_1N_{20}P_{20}K_{40}$ | 26.3 | 7.48 | 28.07 | 0.66 | 27.18 | 4.07 |
| $S_2$ $N_{40}P_{20}K_{40}$ | 24 | -4.49 | 26 | 4.76 | 25 | 0.13 |
| $S_2N_{40}P_{60}K_{20}$ | 23.6 | -5.87 | 20 | -19.21 | 21.8 | -12.54 |
| $S_2N_{20}P_{40}K_{20}$ | 24.8 | -1.49 | 22 | -11.91 | 23.4 | -6.7 |
| $S_2N_{20}P_{60}K_{40}$ | 26 | 3.16 | 27.2 | 9.5 | 26.6 | 6.63 |
| $S_2N_{40}P_{40}K_{20}$ | 25.33 | 1.04 | 24 | -3.03 | 24.66 | -0.99 |
| $S_2N_{20}P_{40}K_{40}$ | 26.4 | 5 | 23.47 | -5.3 | 24.93 | 0.15 |
| $S_2N_{40}P_{20}K_{20}$ | 26 | 3.68 | 28 | 12.63 | 27 | 8.15 |
| $S_2N_{40}P_{60}K_{40}$ | 26 | 3.93 | 22 | -11.87 | 24 | -3.97 |
| $S_2N_{40}P_{40}K_{40}$ | 26 | 3.52 | 25.2 | 1.46 | 25.6 | 2.49 |
| $S_2N_{20}P_{60}K_{20}$ | 26 | 3.73 | 22 | -11.46 | 24 | -3.86 |
| $S_2N_{20}P_{20}K_{20}$ | 26 | 4.09 | 23.2 | -6.01 | 24.6 | -0.96 |
| $S_2N_{20}P_{20}K_{40}$ | 25.2 | -0.04 | 22 | -11.7 | 23.6 | -5.87 |
| $S_3$ $N_{40}P_{20}K_{40}$ | 26 | 5.05 | 22.8 | -18.51 | 24.4 | 6.73 |
| $S_3N_{40}P_{60}K_{20}$ | 28 | 13.1 | 32 | 13.56 | 30 | 13.33 |
| $S_3N_{20}P_{40}K_{20}$ | 26 | 5.03 | 26 | -7.31 | 26 | -1.14 |
| $S_3N_{20}P_{60}K_{40}$ | 26 | 5.39 | 26 | -7.84 | 26 | -12.25 |
| $S_3N_{40}P_{40}K_{20}$ | 26 | 4.94 | 24 | -14.4 | 25 | -4.73 |
| $S_3N_{20}P_{40}K_{40}$ | 24.8 | 0.19 | 24 | -14.62 | 24.4 | -7.21 |
| $S_3N_{40}P_{20}K_{20}$ | 26 | 4.94 | 24 | 15.24 | 25 | 10.09 |
| $S_3N_{40}P_{60}K_{40}$ | 24 | -3.15 | 22.2 | -21.38 | 23.1 | -12.26 |
| $S_3N_{40}P_{40}K_{40}$ | 26 | 5.62 | 32 | 13.83 | 29 | 9.72 |
| $S_3N_{20}P_{60}K_{20}$ | 25.2 | 1.67 | 24 | -14.67 | 24.6 | -6.5 |
| $S_3N_{20}P_{20}K_{20}$ | 24 | -2.82 | 24 | -14.55 | 24 | -8.68 |
| $S_3N_{20}P_{20}K_{40}$ | 24 | -2.89 | 22 | -2.03 | 23 | -12.46 |
| $S_4$ $N_{40}P_{20}K_{40}$ | 26 | -1.71 | 27.33 | -15.8 | 26.66 | -8.75 |
| $S_4N_{40}P_{60}K_{20}$ | 26.4 | -0.89 | 26.4 | -18.31 | 26.4 | -9.6 |
| $S_4N_{20}P_{40}K_{20}$ | 26.4 | -0.73 | 36 | 11.48 | 31.2 | 5.37 |
| $S_4N_{20}P_{60}K_{40}$ | 26 | 1.51 | 26 | -19.7 | 26 | -10.6 |
| $S_4N_{40}P_{40}K_{20}$ | 24 | -9.6 | 32 | -1.09 | 28 | -5.34 |
| $S_4N_{20}P_{40}K_{40}$ | 30 | 13.35 | 26 | -19.64 | 28 | -3.14 |
| $S_4N_{40}P_{20}K_{20}$ | 27.2 | 1.97 | 24 | -26.02 | 25.6 | -12.02 |
| $S_4N_{40}P_{60}K_{40}$ | 25.6 | -4.17 | 22.8 | -29.6 | 24.2 | -16.88 |
| $S_4N_{40}P_{40}K_{40}$ | 26 | -2.28 | 26 | -19.92 | 26 | -11.1 |
| $S_4N_{20}P_{60}K_{20}$ | 25.2 | -4.57 | 36 | 11.67 | 30.6 | 3.55 |
| $S_4N_{20}P_{20}K_{20}$ | 25.93 | -1.88 | 32 | -1.25 | 28.96 | -1.56 |
| $S_4N_{20}P_{20}K_{40}$ | 28 | 5.46 | 36 | 11.65 | 32 | 8.55 |
| SEm(±) | 0.08 | 0.61 | 0.98 | 6.14 | 0.99 | 0.71 |
| CD at 5% | 0.23 | 1.71 | 2.76 | 17.26 | 2.67 | 1.92 |

(31.0%), $N_{40}P_{60}K_{40}$ (31.0%) and their difference was statistically significant except later two treatments. Other treatment combinations showed medium level of disease incidence (32% - 33%) and their difference was statistically significant except few exceptions. In the year 2014, the minimum disease incidence was observed in $N_{20}P_{60}K_{40}$ (31.0%) followed by $N_{40}P_{20}K_{40}$ (32.0%), $N_{40}P_{40}K_{20}$ (32.0%), $N_{40}P_{20}K_{20}$ (32.0%) and their difference was statistically significant except later three treatments. The maximum disease incidence was observed in $N_{20}P_{60}K_{20}$ (35.0%) followed by $N_{20}P_{20}K_{40}$ (34.0%), $N_{20}P_{60}K_{20}$ (34.0%), though their difference was statistically significant except later two treatments. The two years pooled mean showed the minimum disease incidence in $N_{40}P_{20}K_{40}$ (31.0%) followed by $N_{40}P_{60}K_{20}$ (32.0%), $N_{20}P_{60}K_{40}$ (32.0%), $N_{40}P_{40}K_{20}$ (32.0%), $N_{40}P_{20}K_{20}$ (32.0%) and $N_{40}P_{60}K_{40}$ (32.0%), though their difference was statistically significant except later five treatments. The maximum disease incidence was noticed in $N_{20}P_{60}K_{20}$ (34.5%) statistically at par with $N_{20}P_{20}K_{40}$ (34.0%) treatment combinations. No significant difference in disease severity was observed among the treatments were $N_{20}P_{40}K_{40}$, $N_{40}P_{40}K_{40}$, $N_{20}P_{40}K_{20}$, and $N_{20}P_{20}K_{20}$ treatment combinations, though they exhibited the medium level of disease incidence which was significantly lower than untreated control (Table 1).

It was observed from the above experiments that $N_{40}P_{20}K_{40}$ exhibited minimum disease incidence in every data of observation and in every fertility gradient soil. So, increased the level of nitrogen and potassium in every fertility gradient soil reduced the disease severity irrespective of phosphorus application. Among the two levels of N, P and K highest amount of N and K levels applied combinedly reduced the disease incidence of *Sclerotium* root rot of groundnut. Application of N and K levels also effect the foliar diseases of potatocrops (Mahapatra *et al*. 2012; Mitra *et al*. 2014).

***Fertility gradient with NPK combinations on kernel yield of groundnut***

Different NPK levels in different fertility gradient soil also showed different kernel yield in three different years and in pooled mean and their differences were statistically significant. In 2013, maximum kernel was noticed in $S_4N_{20}P_{40}K_{40}$(30 q $ha^{-1}$), $S_3N_{40}P_{60}K_{20}$(28q$ha^{-1}$), $S_4N_{40}P_{20}K_{20}$ (27.2 q $ha^{-1}$)and $S^1N_{40}P_{40}K_{40}$ (26.8 q $ha^{-1}$). Minimum kernel yield was noticed in S2N40P20K20 (23.60 q $ha^{-1}$), S3N40P60K40 (24 q $ha^{-1}$), $S_4N_{40}P_{40}K_{20}$(24 q $ha^{-1}$), $S^1N_{40}P_{40}K_{20}$ (24 q $ha^{-1}$)and $S^1N_{40}P_{20}K_{40}$. (24.8 q $ha^{-1}$). Other treatment combinations showed no significant differences in kernel yield among themselves in respect to per cent increase in kernel yield. In 2014, maximum kernel yield was obtained from three treatment combination $S_4N_{20}P_{60}K_{20}$(36.00q/ha) $S_4N_{20}P_{40}K_{20}$(36.00 q ha-1)and $S_4N_{20}P_{20}K_{40}$(36.00 q ha-$^1$) Minimum kernel yield were observed from treatments,$S^1N_{20}P_{40}K_{40}$ (20.00 q $ha^{-1}$), $S_1N_{20}P_{60}K_{40}$(22.00 q $ha^{-1}$),$S_2N_{20}P_{20}K_{40}$(22.00 q $ha^{-1}$), $S_2N_{20}P_{40}K_{20}$(22.00 q $ha^{-1}$),$S_2N_{20}P_{60}K_{20}$(22.00 q $ha^{-1}$) $S_3N_{20}P_{60}K_{40}$(26.00 q $ha^{-1}$) $S_3N_{40}P_{20}K_{40}$(27.33 q $ha^{-1}$ $S_3N_{40}P_{60}K_{40}$(22.20 q $ha^{-1}$) and $S_4N_{40}P_{60}K_{40}$(25.60 q $ha^{-1}$.) No significant differences among the rest of the treatment combinations. In this year all the treatment combinations reduced the kernel yield over untreated control except in $S^1N_{20}P_{20}K_{20}$(24.00 q $ha^{-1}$) $S^1N_{40}P_{40}K_{20}$(29.33 q $ha^{-1}$) $S_2N_{20}P_{60}K_{40}$ (27.20q$ha^{-1}$),$S_2N_{40}P_{20}K_{20}$(28.00q $ha^{-1}$),$S_2N_{40}P_{20}K_{40}$(26.00 q $ha^{-1}$), $S_2N_{40}P_{40}K_{40}$(25.20 q ha-$^1$) $S_3N_{40}P_{40}K_{40}$(32.00 q $ha^{-1}$) $S_3N_{40}P_{60}K_{20}$(32.00 q ha-$^1$) $S_4N_{20}P_{20}K_{40}$(36.00 q $ha^{-1}$) $S_4N_{20}P_{40}K_{20}$(36.00) q $ha^{-1}$) and $S_4N_{20}P_{60}K_{20}$(36.00 q ha-$^1$) where kernel yield was increased over untreated control though their differences were not statistically significant among themselves. Percent decreased in kernel yield in different treatment combinations showed significant differences among themselves and maximum was observed in $S_4N_{40}P_{60}K_{40}$(22.80 q $ha^{-1}$)and minimum in $S^1N_{40}P_{40}K_{40}$ (28.00 q $ha^{-1}$) (Table 2).

Two years pooled mean showed difference in kernel yield in different treatments and their differences were statistically significant. Maximum kernel yield was obtained in $S_4N_{20}P_{60}K_{20}$ (26.4 q $ha^{-1}$) statistically at par with $S_4N_{20}P_{60}K_{20}$ (25.2 q $ha^{-1}$) where as minimum kernel yield was in $S_2N_{40}P_{60}K_{20}$ (19.2 q $ha^{-1}$) statistically at par with $S_3N_{20}P_{20}K_{40}$, $S_2N_{20}P_{60}K_{20}$, $S^1N_{40}P_{20}K_{40}$, $S^1N_{20}P_{40}K_{40}$, $S_3N_{40}P_{20}K_{40}$, $S_2N_{40}P_{20}K_{40}$ and $S_3N_{40}P_{60}K_{40}$. No significant differences in kernel yield were observed among the treatments like $S_4N_{40}P_{60}K_{40}$, $S_4N_{40}P_{60}K_{20}$, $S_4N_{40}P_{40}K_{40}$, $S_4N_{40}P_{20}K_{40}$, $S_4N_{40}P_{20}K_{20}$, $S_4N_{20}P_{60}K_{40}$, $S_4N_{20}P_{40}K_{20}$, $S_4N_{20}P_{20}K_{20}$, $S_3N_{40}P_{20}K_{20}$, $S_3N_{20}P_{60}K_{40}$, $S_3N_{20}P_{60}K_{20}$, $S_3N_{20}P_{40}K_{40}$, $S_3N_{20}P_{40}K_{20}$, $S_3N_{20}P_{20}K_{20}$, $S_2N_{40}P_{60}K_{40}$, $S_2N_{40}P_{40}K_{40}$, $S_2N_{40}P_{40}K_{20}$, $S_2N_{40}P_{20}K_{40}$, $S_2N_{20}P_{40}K_{40}$, $S_2N_{20}P_{40}K_{20}$, $S_2N_{20}P_{20}K_{20}$, $S^1N_{40}P_{60}K_{40}$, $S^1N_{40}P_{60}K_{20}$, $S^1N_{40}P_{40}K_{40}$, $S^1N_{40}P_{40}K_{20}$, $S^1N_{40}P_{20}K_{20}$, $S^1N_{20}P_{60}K_{40}$ and $S^1N_{20}P_{60}K_{20}$. Per cent increase in kernel yield of different NPK combinations in different fertility gradient soil showed differential reactions. In low fertility gradient soil (S1), all the NPK combinations reduced the kernel yield over untreated control except in $S^1N_{20}P_{20}K_{40}$ and $S^1N_{20}P_{40}K_{20}$ though their differences were not statistically significant in respect to reduction and increase in kernel yield. In moderate fertility gradient soil (S2) all the NPK combinations increased the kernel yield over untreated control except in $S_2N_{20}P_{40}K_{20}$, $S_2N_{20}P_{40}K_{40}$, $S_2N_{20}P_{60}K_{20}$, $S_2N_{40}P_{40}K_{40}$ and $S_2N_{40}P_{60}K_{20}$ treatments. Here also observed that, the treatment combinations, which decreased or increased the kernel yield showed no significant differences among themselves. In medium fertility gradient soil (S3), all the NPK combinations also increased the kernel yield over untreated control except in $S_3N_{20}P_{20}K_{40}$, $S_3N_{20}P_{60}K_{40}$, $S_3N_{40}P_{20}K_{20}$, $S_3N_{40}P_{20}K_{40}$ and $S_3N_{40}P_{60}K_{40}$, treatments. Here also, increase or decrease in kernel yield over untreated control showed no significant differences among themselves. High fertility gradient soil (S4) showed the reverse result, which was similar to that of low fertility gradient soil. All the NPK combinations reduced the kernel yield over untreated control except in $S_4N_{20}P_{40}K_{20}$, $S_4N_{20}P_{60}K_{20}$ and $S_4N_{40}P_{20}K_{40}$treatments, though the treatments which showed increase or decrease in kernel yield over untreated control, their differences were not statistically significant among themselves (Table 2).

Different yield and yield parameters of groundnut showed a positive correlation with NPK nutrition in different fertility gradient soil. Groundnut pod yield increased with increasing higher application of NPK fertilizers (Jakusko and Dakato, 2015). This is an agreement with Toungos *et al*. (2009) who reported application of NPK fertilizers results in higher source capacity which may translate into higher dry matter production which may later be allocated to the pods for higher yield.

Our result showed some insignificant erratic result in low and high fertility gradient soil in respect to kernel yield in different NPK nutrition.Whereas, in medium and moderate fertility soil, increased N and P levels increased the kernel yield of groundnut, which confirmed the result of Toungos *et al*.(2009) and Jakusko and Dakato (2015).

The result therefore suggested that the NPK combination required for different fertility gradient soil for maximum yield and minimum Sclerotium rot incidence were $N_{40}P_{40}K_{20}$ in low fertility gradient , $N_{40}P_{20}K_{20}$ in medium fertility gradient, $N_{40}P_{60}K_{20}$ in moderate fertility gradient and $N_{20}P_{20}K_{40}$ in high fertility gradient soil condition.

## REFERENCES


Jakusho, B.B. and Dakato, M.E. 2015. Effect of NPK fertilizer rates on seed yield of some local cultivars of Bambara Groundnut (*Vigna subterranean* (L.) *Verde*). *International Journal of Chemical, Environmental and Biological Science* (IJCEBS). **3:** 67-70.

Mitra, Kalyan Naskar,Buddhadeb Rama, J.P. and Das., Srikanta 2014. Effect of different fertilizers combination on early blight of Potato under diverse fertility gradient soil. *International Journal of Bioresource Science*. **1:** 73-82.

Partha Datta, B. Dasgupta and Srikanta Das.2011. Efficacy of Trichoderma spp. against *Sclerotium rolfsi*.*Journal of Mycopathological Research*. **49 :** 31-38.

Mahapatra, Sunita Chakraborty, Ayana Ahmed, Zubair Nath P.S. and Das., Srikanta 2012. Effect of different levels of nitrogen and potassium on foliar disease severity of potato under different fertility soils. *Journal of Mycopathological Research.* **50** : 211-216.

Toungos, M. D, Sajo, A.A. and Gungula, D.T. 2009. Recommended fertilizer levels on Bambara Groundnut (*Vigna subterranean* (L.) *Verde*) in Yola, Adamawa State, Nigeria. *Agricultural Journal*. **4:** 14-21.

Yampi, Nani. 2007. Different *NPK combinations against Sclerotium rot of groundnut under different fertility gradient soil condition.* M. Sc. (Ag) Thesis Bidhan Chandra Krishi Viswavidyalaya. 1-51 pp.