CONTENTS

SUMMARY AND CONCLUSION

EFFECT OF NITROGEN FERTILIZATION AND SULFUR UNDER COMPOST APPLICATION ON POTATOES

Two field experiments were conducted at soil of Battera village, Talkha district, Dakahlia Governorate, Egypt, during the two successive growing seasons of summer 2002/2003 and winter 2003/2004 to study the effect of nitrogen fertilization and sulfur under compost rice straw application on potatoes (*Solanum tuberosum*, L.) cultivar Spunta and soil properties.

The treatments used as follows:

1- The first factor (Compost rice straw) Three levels of compost were applied as follows:
   - (C0): Zero compost (without application)
   - (C1): 6 ton compost / fed.
   - (C2): 12 ton compost / fed.

2- The second factor (Sulfur) two rate of sulfur was applied 0 and 150 kg S/fed from two sources:
   - (S0): 0 kg sulfur (without application).
   - (S1): 150 kg S/fed as elemental sulfur (99.5% S).
   - (S2): 150 kg S/fed as gypsum (18.60% S).

3- The third factor (Nitrogen) three rates of nitrogen was applied 0, 100 and 150 kg N/fed from two sources:
   - (N0): 0 kg N/fed.(control, without application)
   - (N1): 100 kg N/fed as urea (46.5% N).
   - (N2): 150 kg N/fed as urea (46.5% N).
   - (N3): 100 kg N/fed as ammonium nitrate (33.5% N).
   - (N4): 150 kg N/fed as ammonium nitrate (33.5% N).

The experimental design was a split split plot design with 3 replicates. The three levels of compost (C) were the main plots, while, the three treatments of sulfur (S) were the sub-plots, and, the five treatments of nitrogen (N) were the sub-sub plots.

The obtained results could be summarized as follows:

1- Effect of nitrogen, sulfur and compost and their interactions on plant growth of potatoes after 90 days from planting:

1-1- Plant height (cm):

- Nitrogen fertilization (N), sulfur addition (S) and Compost application (C) increased plant height significantly after 90 days from potato planting in both seasons. The differences between N treatments and N sources were insignificantly in both seasons.
- The superiority was due to applying N at rate 150 kg/fed as urea, sulfur at rate 150 kg/fed as elemental and compost at rate 12 t/fed in both seasons.

1-2- Leaf area (m^2/plant):

- Leaf area (m^2/plant) was increased highly significantly at 90 days in both seasons as affected by addition of nitrogen fertilization, sulfur, and compost. While, the effect of different interactions on leaf are (m^2/plant) were insignificant in both seasons. The highest mean of leaf area in both seasons was with N4 (150 kg N as ammonium nitrate) +S1+C2.

1-3- Total chlorophyll:

- N, S, and C addition increased T.Chlo. highly significant in both seasons as compared to control.. While, the effect of interactions CxS, CxN, SxN and CxSxN on total chlorophyll was high significant in 1st season, but insignificant in 2nd season. The differences between the two levels of N were insignificant while, between S sources or C levels were significant.

- Treatments N3, S1 or C2 recorded the highest means of total chlorophyll in both seasons.

2- Effect of nitrogen, sulfur and compost and their interactions on yield of potatoes.

2-1- Fresh tuber yield (t/fed).

- Nitrogen, sulfur and compost addition increase fresh tuber yield (t/fed) high significantly in both seasons.
- Effect of interaction CxS on tuber yield was insignificant in both seasons. While, the effect of interaction CxN was significant in 1st season and high significant in 2nd season. Also, the effect of interactions SxN and CxSxN were insignificant in 1st season but, were high significant in 2nd season.
- The maximum mean of fresh tuber yield was at N4 (150 N/fed as NH_4NO_3) + S1 (150 kg S/fed as elemental) + C2 (12 ton compost / fed), in both seasons. The difference between the two seasons was attributed to variance between seed tubers sources.

2-2- Dry shoot yield (t/fed):

- N, S, and C application increased dry shoot yield highly significant in both seasons.
- The effect of interactions CxN, SxN and CxSxN on dry shoot yield was high significantly in both seasons. While the effect of interaction CxS was significant in 1st season and insignificant in 2nd season.
- The superiority was recorded with S1 and C2 in both seasons. While both were with N4 in 1st season and N3 in the 2nd season.

2-3- Dry tuber yield (t/fed).

- Dry tuber yield was increased significantly in both seasons with nitrogen (N), sulfur (S), and compost (C) addition and their interactions as compared to the control. The differences between the two sources of N were significant in 1st season and insignificant in 2nd season. On the other hand, they were significant with S sources or C levels in both seasons.
- The highest dry tuber yield was with interaction of N4+S1+C2 (150 kg N/fed as NH_4NO_3 +150 kg S/fed as element + 12 ton compost/fed).

3- Effect of nitrogen, sulfur and compost and their interactions on chemical composition of potatoes after 110 days.

3-1- N% in shoot

- The percentage of N in shoot was increased significantly with nitrogen, sulfur and compost additions and their interactions as compared with control in both seasons.
- There were no significance differences between N sources. Elemental sulfur (S1) and level C2 of compost gave the highest N% in shoot in both seasons.

3-2- N% in tuber

- N% in tuber was affected high significantly by nitrogen, sulfur and compost additions and their interactions in both seasons.
- The maximum mean of N% in tuber was with interaction among 100 kg N/fed as ammonium nitrate + 150 kg S/fed as element and 12 ton compost/fed in both seasons.

3-3- P% in shoot

- P% in shoot was increased highly significant with N and C application in both seasons, except S addition was insignificant in 1st season. While, the interactions effects were significant in both seasons except CxS and CxSxN were insignificant in 2nd season.
- Ammonium nitrate gave the highest P% in shoot especially at the high rate of 150 kg N/fed in 1st season. Also, elemental S (S1) and level C2 (12 t/fed) gave the high means of P% in both seasons.

3-4- P% in tuber

- N, S, and C application increased P% in tubers high significantly in both seasons. While the effect of interactions were insignificantly in both seasons, except, CxN and CxSxN were highly significant in 1st season.
- The highest P% in tubers was at the high level of N fertilization as ammonium nitrate or with S1 (150 kg S/fed as element) or with C2 (12 ton compost/fed).

3-5- K% in shoot

- Nitrogen, sulfur and compost application and their interactions gave a highly significant increases in shoot K% in both seasons, but S, C gave insignificant increases in 1st season. The highest value of K% in shoots was with N3+S1+C2 in both seasons.

3-6- K% in tuber

- Potassium (K) concentration in tubers was affected highly significantly by nitrogen (N), sulfur (S), and compost (C) addition and their interactions in both seasons.

- The differences between the two N rates (100 and 150 kg N/fed) and sources were not obvious in both seasons. While, S1 and C2 gave the highest effect.

4- Effect of nitrogen, sulfur and compost and their interactions on tuber quality of potatoes after 110 days.

4-1- Dry matter% of tuber

- Nitrogen addition increased dry matter% of tuber highly significant in both seasons. Sulfur and compost application significantly increased the dry matter% of tuber in 1st season and insignificant in 2nd season.
- The effect of interactions on dry matter% was insignificantly at harvest in both seasons, except the CxN was highly significant in 1st season.
- The superiority was for ammonium nitrate at 150 kg N/fed in 1st season while, the differences did not reach to the level of significance in 2nd seasons. It is obvious that elemental S and C2 (12 ton compost/fed) gave the highest DM% in both seasons.

4-2- Tuber specific gravity

- Nitrogen application decreased tuber specific gravity (SG) highly significantly in both seasons. While sulfur addition increased SG highly significant in both seasons. But the compost application decreased SG significantly in 1st season and highly significantly in 2nd season. The interactions decreased SG significantly in both seasons. And more study is needed to increasing SG through added more K with the treatments used.
- The highest mean of specific gravity was with control (without additions).

4-3- Starch % in tuber

- N fertilization decreased starch % in tubers highly significant in both seasons. In addition, sulfur addition increased starch % in tuber high significantly in 1st season but, in 2nd season the starch% was decreased high significantly. Compost (C) application decreased the starch% in tuber insignificantly in 1st season and high significantly in 2nd season.
- The percentage of starch in tubers was decreased high significantly under the effect of interactions in both seasons. More studied is needed to increases SG through increasing starch% in tubers by K application with the studied treatments.
- The highest means of starch % in tubers were with N0, S1 and C1 in 1st season and with N0, S0 and C0 in 2nd season.

4-4- Protein % in tuber

- N, S and C application and their interactions increased the percentage of protein significantly in booth season except S in 1st season was insignificant.
- There was no constant trend between N rates and sources in both seasons. While elemental sulfur and C2 (12 ton compost/fed) recorded the highest means of protein % in tubers.

5- Effect of nitrogen, sulfur and compost and their interaction on soil after harvesting of potatoes.

5-1- Bulk density (g/cm^3)

- Nitrogen fertilization had insignificant effect on bulk density (BD) in both seasons. While, Sulfur application decreased the values of BD

significantly as compared with control in 1st season and insignificant in 2nd season. Also, compost addition decreased BD highly significant in both seasons.

- The effects of interactions CxS, CxN, SxN and CxSxN on bulk density of soil after harvest were insignificantly in both seasons. The lowest value of BD observed with interactions among N3+S2+ C2 in both seasons.
- It is obvious that treatment S2 as gypsum-S gave lower values than treatment S1 as elemental-S, where, the highest applications of 12 ton compost/fed gave the lowest BD.

5-2- Total porosity % (TP%)

- Nitrogen fertilization had insignificantly effects on TP% of soil in both seasons. While, sulfur addition increased total porosity of soil insignificantly in 1st season and significantly in 2nd season. Compost addition increased TP% high significantly in both seasons.
- Effects of interactions CxN, SxN, CxS and CxSxN on TP% were insignificantly in both seasons, except CxS was high significant in 1st season.
- The highest value of TP% was with interaction between C2 (12 t/fed) and S2 (150 kg S/fed as gypsum) in 1st season and among N4+S2+C2 in 2nd season.

5-3- Saturation percentage (SP)

- SP was decreased with N fertilization highly significant in 1st season and significantly in 2nd season.

- SP of soil was not affected by sulfur application in both seasons.
- The means of SP were increased highly significant by compost application in both seasons.
- The effect of interaction CxS, CxN, SxN and CxSxN on SP were significantly in 1st season and insignificantly in 2nd season.
- The superiority was with C2 (12 t/fed).

5-4- Available soil NH_4^+- N (ppm)

- Application of nitrogen, sulfur and compost increased available N-NH_4^+ highly significant as compared with control in both seasons.
- The effect of interaction CxN was highly significantly in both seasons. While, the interactions CxS, SxN and CxSxN were insignificantly in both seasons.
- The maximum value of available N-NH_4^+ was obtained by the interactions among N2 (150 kg N/fed as a urea) + S1 (150 kg S/fed as element) and C2 (12 ton compost/fed) in both seasons.

5-5- Available nitrogen as NO_3^- -N (ppm)

- The means of available NO_3^- -N increased significantly in both seasons with increasing nitrogen, sulfur, and compost application and their interactions except CxS in both seasons.
- The superiority was with interaction among N4 (150 kg N/fed as NH_4NO_3) + S1 (150 kg S/fed as elemental) and C2 (12 ton compost/fed) in both seasons. It is recommended by more study between the used treatments to decrease NO_3^-N in soil to save it reflection in tubers.

5-6- Available phosphorus (ppm)

- Available (P) was increased in the soil with increasing the applied rates of nitrogen, and compost significantly in both seasons as compared with control. While, with Sulfur these increases were insignificantly in both seasons. Elemental S was more effective than gypsum.
- Effect of interaction CxS on available P was insignificantly in both seasons. On the other hand the effect of interaction CxN was high significant. While, the effect of interactions SxN and CxSxN on available P were insignificantly in 1st season and highly significant in 2nd season.
- The highest value of available P in soil was observed with interaction N4+S1+C2 in both seasons.

5-7- Available potassium (ppm)

- Available K was increased significantly in both seasons by the application of nitrogen, sulfur and compost and their interactions. Except N fertilization in 2nd season decreased available K high significantly.
- The highest mean of available K was observed with S1 and C2 in both seasons and with S1 + C2 + N4 in 1st season.

CONCLUSION

Finally, the present study is recommended that the application of 150 kg N/fed as ammonium nitrate + 150 kg S/fed as element + 12 ton compost/fed of rice straw with the constant background of recommended doses of phosphorus 75 kg P_2O_5/fed as super-phosphate and potassium (96 kg K_2O/fed as potassium sulfate) to obtain high fresh and dry yields of tubers and shoots.