

# ROLE OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI ON RICE CROP WITH DIFFERENT DOSE OF FERTILIZER TO SAVE SUSTAINABILITY

## ABSTRACT

The word “sustainability” has recently come to find itself pushed forward into the limelight and attached as a modifier to nouns with which it formerly had no more than a nodding acquaintance. “Sustainable development,” for example, has been with us for some time, but more recent pairings are now commonplace: sustainable agriculture, sustainable design, sustainable energy, sustainable tourism, and sustainable living, to name a few. Remind of view sustainability my research works carried out to solve this problem to save sustainable development. An experiment was conducted during rainy (Kharif) season 2015, to find out the effect of fungal isolates with different dose of fertilizer on growth yield attributes of rice. The experiment comprises three replication and seven treatment combinations. The rice variety–PB1509 was transplanted with pot experiment. The results showed that application of T<sub>1</sub> (N<sub>0</sub> P<sub>0</sub> K<sub>0</sub>) (control), T<sub>2</sub> (N P K), T<sub>3</sub> (N<sub>¼</sub> P<sub>¼</sub> K), T<sub>4</sub> (N<sub>½</sub> P<sub>½</sub> K), T<sub>5</sub> (N<sub>½</sub> P<sub>½</sub> K + VAMV-SI/4), T<sub>6</sub> (N<sub>½</sub> P<sub>½</sub> K + VAMV-SII/5) and T<sub>7</sub> (N<sub>½</sub> P<sub>½</sub> K+ VAM-SIII/3) gave significantly yield attributes were also higher in this treatment (T<sub>5</sub>) over control and other treatments.

**Keywords:** Sustainability; basmati-rice; growth; yield; vesicular-arbuscular mycorrhiza; kharif.

## INTRODUCTION

The word mycorrhizae is derived from two Greek words, mycos and rhizos, meaning fungus and root, respectively. Mycorrhizal association forms a

very dynamic and beneficial relationship that exists between arbuscular mycorrhizal fungi (AMF) and roots of higher plants (vascularplants). More than 80% of terrestrial plants form association with mycorrhizal fungus except some



Treatment	Tillers/pot
T <sub>1</sub> ( N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	25.3
T <sub>2</sub> (N P K)	35.6
T <sub>3</sub> (N <sub>34</sub> P <sub>34</sub> K)	33.3
T <sub>4</sub> ( N <sub>12</sub> P <sub>12</sub> K )	32
T <sub>5</sub> (N <sub>12</sub> P <sub>12</sub> K + VAM-SI/4)	36.9
T <sub>6</sub> (N <sub>12</sub> P <sub>12</sub> K + VAM-SII/5)	35.3
T <sub>7</sub> (N <sub>12</sub> P <sub>12</sub> K+ VAM-SIII/3)	35.6
CD (P=0.05)	1.48
CV	4.23

#### Effective Tillers/Pot

Number of effective tillers per pot presented in Table 2 revealed that affected by fertilizer dose and different isolates of VAM fungi was increased

significantly and varies from 20 effective tiller per pot in absolute control to 32.0 tiller per pot in the

treatment T<sub>2</sub> (N P K) with full dose of fertilizer and T<sub>5</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) which received half dose of N P and full doses of K and N P, and full dose of K with fungal isolates VAM-SI/4. Further more, the increase in N and P fertilizer dose from 50% to 75% and 100% increased the total number of effective tillers per pot significantly over absolute control. Full doses of fertilizer caused 26.08% increase in number of effective tillers over the absolute control. Fungal isolates tested at 50% N, P, and full dose of K showed significant increase in number of effective tillers. The highest increase in number of effective tillers (21.67%) was recorded with VAM-SI/4 increase in number of effective tillers over without isolate.

**Table 2. Effect of VAM fungi on effective tiller growth of rice.**

Treatment	Effective tillers/pot
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	20.3
T <sub>2</sub> (N P K)	31.9
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	27.3
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	26.3
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	31.9
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	30.6
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	30
CD (P=0.05)	1.17
CV	3.94

### Plant Height

Plant height presented in Table 3 revealed that affected by fertilizer dose and different isolates of VAM fungi was increased significantly and varies from 80.3 cm plant height in absolute control to 102.6 cm in the treatment T<sub>7</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3) which received half dose of N, P and full doses of K with fungal isolates VAM-SIII/3. Further the increase in N and P fertilizer dose from 50% to 75% and 100% increased the plant height significantly over absolute control. Full dose of fertilizer resulted in a caused 24.53% increase in plant height over the absolute control. Fungal isolates tested at 50% N, P, and full dose of K increased significantly in plant height with all isolates. The highest increase in plant height (58.08%) was recorded with isolates VAM-SIII/3 increase in plant height over without isolate the control treatment.

**Table 3. Effect of VAM fungi on plant height of rice**

Treatment	Plant height (cm)
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	80.3
T <sub>2</sub> (N P K)	100
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	66.3
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	64.9
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	100.9
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	101.3
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	102.6
CD (P=0.05)	4.11
CV	4.44

### Panicle Length

Panicle length presented in Table 4 revealed that affected by different fertilizer dose with isolates of VAM fungi was increased significantly and varies from 13.6 cm in absolute control to 17.6 cm in the treatment T<sub>5</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) which received half dose of N, P and full dose of K with fungal inoculant VAM-SI/4. Further the increase in N and P fertilizer dose from 50% to 75% and 100% increased the panicle length significantly over absolute control. Full dose of fertilizer caused 24.28% increase in panicle length over the absolute control. Fungal isolates tested at 50% N, P, and 100% of K increased significantly in panicle length. The highest increase in panicle length (23.07%) was recorded with inoculant VAM-SI/1 increase panicle length over without isolate.

**Table 4. Effect of VAM fungi on panicle length of rice**

Treatment	Panicle Length (cm)
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	13.6
T <sub>2</sub> (N P K)	16.9
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	17.3
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	14.3
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	17.6
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	17.3
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	17.4
CD (P=0.05)	0.96
CV	5.56

### Grain Yield

Grain yield presented in Table 5 revealed that affected by fertilizer dose and different isolates of VAM fungi was increased significantly and varies from 9.6 g/pot in absolute control to 15.6 g/ pot in the treatment T<sub>5</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) which received half doses of N, P and full dose of K with

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fungal isolate VAM-SI/4. Further the increase in N and P fertilizer dose from 50% to 75% and 100% increased the grain yield per pot significantly over absolute control. Full dose of fertilizer resulted in 41.66% increase in grain yield over the absolute control. Fungal isolates tested at 50% N, P<sub>2</sub> and 100% of K increased significantly in grain yield. The highest increase grain yield (20.0%) increase in grain yield over without isolate.

**Table 5. Effect of VAM fungi on grain yield of rice**

Treatment	Grain yield
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )(control)	9.6
T <sub>2</sub> (N P K )	13.6
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K) T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	13.3
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	13
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	15.6
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K+ VAM-SIII/3)	14
CD (P=0.05)	14.6
CV	0.83
	5.91

### Straw Yield

Straw yield per pot presented in Table 6 revealed

that affected by fertilizer dose and different isolates of VAM fungi was increased significantly and varies from 21.3 g/pot in absolute control to 26.8 g/pot in the treatment T<sub>7</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3) which received half dose of N, P and full dose of K with fungal inoculant VAM-SIII/3. Further, the increase in N and P fertilizer dose from 50% to 75% and 100% increased the straw yield per pot significantly over absolute control. Whereas, the full dose of fertilizer caused increased by 10.79% increase in the straw yield over the absolute control. Fungal isolates tested at 50% N, P<sub>2</sub> and 100% of K increased significantly in straw yield. The highest increase in straw yield (17.03%) was recorded with VAM-SIII/3 increase in straw yield over without isolate.

### Test Weight

Test weight per pot presented in Table 7 revealed that affected by fertilizer dose and different isolates of VAM fungi was increased significantly and varies from 13.6 g in absolute control to 16.4 g in the treatment T<sub>7</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3) which received half dose of N, P and full dose of

K with fungal isolates VAM-III/3. Further the increase in N and P fertilizer dose from 50% to 75% and 100% increased the test weight significantly over absolute control. Full dose of fertilizer caused 7.35% increase in test weight over the absolute control. Fungal isolates tested at 50% N, P and 100% of K increased significantly in test weight. The highest increase in test weight (20.58%) was recorded with inoculant VAM-SIII/3 increases in test weight over without isolate.

**Table 6. Effect of VAM fungi on straw yield of rice**

Treatment	Straw yield
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )(control)	21.3
T <sub>2</sub> (N P K )	23.6
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K) T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	23.9
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	22.9
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	22.9
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K+ VAM-SIII/3)	25.6
CD (P=0.05)	23
CV	26.8
	1.03
	4.11

**Table 7. Effect of VAM fungi on test weight of rice**

Treatment	Test weight
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )(control)	13.6
T <sub>2</sub> (N P K )	14.9
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K) T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	14
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	13.6
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	16.2
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K+ VAM-SIII/3)	16
CD (P=0.05)	16.4
CV	0.73
	4.70

### Effect of VAM on Nutrient Content in Grain and Straw of Rice

#### Nitrogen content (per cent) in grain and straw

Nitrogen content in rice grain and straw presented in Table 8 revealed a great impact of fertilizer dose and fungal inoculants. They increased significantly the nitrogen content in grain as well as straw. Due to different treatment nitrogen content varies from 1.01 to 1.14 and 0.45 to 0.52 per cent in grain and straw respectively. Increasing dose of fertilizers tended to increase nitrogen content in grain and straw. The treatment having full dose of nitrogen and phosphorus

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found to be significantly superior over half dose of fertilizer.

**Table 8. Nitrogen content (per cent) in grain and straw**

Treatment	Nitrogen (%)	
	Grain	Straw
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	1.01	0.45
T <sub>2</sub> (N P K)	1.19	0.52
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	1.16	0.48
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	1.12	0.45
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	1.14	0.46
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	1.14	0.47
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	1.14	0.46
CD (P=0.05)	0.09	0.04
CV	8.10	8.39

**Phosphorous content (per cent) in grain and straw**

Phosphorous content in rice grain and straw presented in Table 9 revealed a great impact of fertilizer dose and fungal inoculants. They significantly influenced the phosphorous content in grain as well as straw. Due to different treatments on phosphorous content varies from 0.27 to 0.35<sub>2</sub> and 0.11 to 0.14 per cent in grain and straw respectively. Increase-Increasing dose of fertilizers from 0 to 1/2, 1/2 to 3/4<sup>th</sup> and 3/4<sup>th</sup> to full dose of fertilizer tended to increase the phosphorous content in grain and straw. The treatment having full dose of nitrogen and phosphorous found to be significantly superior over half, 3/4<sup>th</sup> dose of fertilizer and control. The increase in grain and straw may be due to the fact that the experimental soil was deficient in phosphorous content hence showed better response of applied phosphorous. Application of half dose of N, P<sub>2</sub> and full dose of K and inoculation of selected VAM isolates showed higher phosphorous content in grain and straw than the treatment having half dose of N, P<sub>2</sub> and full dose of K alone.

**Potassium content (per cent) in grain and straw**

Potassium content (per cent) of rice grain and straw presented in Table 10 clearly indicates that the effect of different fertilizer dose and inoculation of selected VAM isolates at 1/2 doses of N and P was insignificant and they varies vary from 0.26 to 0.35<sub>2</sub> and 1.38 to 1.42 in control and full dose of NPK fertilizer respectively.

**Table 9. Phosphorous content (per cent) in grain and straw**

Treatment	Phosphorous (%)	
	Grain	Straw
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	0.27	0.11
T <sub>2</sub> (N P K)	0.35	0.14
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.33	0.13
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.29	0.11
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	0.3	0.12
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	0.3	0.12
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	0.31	0.12
CD (P=0.05)	0.02	0.01
CV	6.47	11.22

**Table 10. Potassium content (per cent) in grain and straw**

Treatment	Potassium (%)	
	Grain	Straw
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	0.26	1.38
T <sub>2</sub> (N P K)	0.35	1.42
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.32	1.41
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.3	1.4
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	0.32	1.41
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	0.31	1.41
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	0.32	1.41
CD (P=0.05)	NS	NS
CV		

**Effect of VAM on Nitrogen, Phosphorus and Potassium (mg pot<sup>-1</sup>) Uptake in Grain and Straw**

**Uptake of nitrogen**

Nitrogen uptake (mg/pot) by grain, straw and total presented in Table 11 revealed that fungal inoculant of VAM significantly increased grain, straw and total uptake of nitrogen. Nitrogen uptake in grain varies from 0.108 mg/pot in control to 0.178 mg/pot in treatment (T<sub>5</sub>) with VAM-SI/4 inoculant. Increasing dose of fertilizer has significantly increased the uptake of N in grain.

The effect of different fertilizer dose and VAM inoculant on nitrogen uptake by straw was significant and they vary from 0.096 mg/pot in control to 0.123 mg/pot in full dose of fertilizer as well as T<sub>7</sub>(N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3).

Total uptake of nitrogen by different dose of fertilizers and fungal inoculants was significant and they vary from 0.203 mg/pot in control to

0.295 mg/pot in VAM treatment T<sub>5</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) with inoculant VAM-SI/4. The increasing dose of fertilizers significantly increased the total N uptake by 3/4<sup>th</sup> and full dose of fertilizer over control.

#### Uptake of phosphorous

Phosphorous uptake (mg/pot) by grain, straw and total presented in Table 12, revealed that fungal inoculant of VAM significantly increased the uptake in grain, straw and total uptake. Phosphorous uptake in grain varies from 0.026 mg/pot in control to 0.047 mg/pot in full dose of fertilizer. Increasing dose of fertilizer has significantly increased the uptake of P in grain.

The effect of VAM treatment in increasing P uptake by grain was much more and significant as compared to without inoculant. The highest P uptake by grain was recorded 0.047 mg/pot in VAM treatment (T<sub>5</sub>) (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) with inoculant VAM-SI/4.

The effect of different fertilizer dose with VAM inoculant on Phosphorous uptake by straw was significant and they varies vary from 0.024 mg/pot in control to 0.033 mg/pot in full dose of fertilizer. Increasing dose of fertilizer has significantly increased the uptake of P in straw. The effect of VAM treatment increasing P uptake by straw was much more and significant as compared to without inoculant.

**Table 11. Nitrogen uptake (mg pot<sup>-1</sup>) in grain and straw**

Treatment	Nitrogen		
	Grain	Straw	Total
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	0.108	0.096	0.203
T <sub>2</sub> (N P K)	0.163	0.123	0.286
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.156	0.115	0.271
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.147	0.103	0.250
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	0.178	0.118	0.295
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	0.160	0.108	0.268
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	0.166	0.123	0.290
CD (P=0.05)	0.03	0.01	0.03
CV	18.70	9.60	10.85

**Table 12. Phosphorous uptake (mg pot<sup>-1</sup>) in grain and straw**

Treatment	Phosphorous		
	Grain	Straw	Total
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	0.026	0.024	0.049
T <sub>2</sub> (N P K)	0.047	0.033	0.081
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.044	0.031	0.075
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.038	0.025	0.063
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	0.047	0.030	0.078
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	0.042	0.028	0.070
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	0.045	0.032	0.077
CD (P=0.05)	0.006	0.004	0.007
CV	14.337	14.085	9.804

**Table 13. Potassium uptake (mg pot<sup>-1</sup>) in grain and straw**

Treatment	Potassium		
	Grain	Straw	Total
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> ) (control)	0.025	0.294	0.319
T <sub>2</sub> (N P K)	0.048	0.335	0.383
T <sub>3</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.043	0.337	0.379
T <sub>4</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K)	0.039	0.321	0.360
T <sub>5</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SI/4)	0.050	0.361	0.411
T <sub>6</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SII/5)	0.044	0.325	0.368
T <sub>7</sub> (N <sub>1/2</sub> P <sub>1/2</sub> K + VAM-SIII/3)	0.047	0.378	0.425
CD (P=0.05)	0.005	0.020	0.024
CV	12.836	5.713	6.098

Total uptake of Phosphorous by different dose of fertilizers and fungal inoculant was significant and they vary from 0.049 mg/pot in control to 0.081 mg/pot in full dose of fertilizer.

#### Uptake of potassium

Potassium uptake (mg/pot) by grain, straw and total presented in Table 13, revealed that microbial inoculant of VAM significantly increased the uptake in grain, straw, and total uptake. Potassium uptake in grain varies from 0.319 mg/pot in control to 0.025 mg/pot VAM treatment T<sub>5</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SI/4) with inoculant VAM-SI/4. Increasing dose of fertilizer has significantly increased the uptake of potassium in grain.

The effect of different fertilizer dose with VAM inoculant on Potassium uptake by straw was significant and they vary from 0.294 mg/pot in control to 0.378 mg/pot in VAM treatment T<sub>7</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3) with inoculant VAM-SIII/3. Increasing dose of fertilizer has significantly increased the uptake of potassium in straw. The effect of VAM treatment in increasing potassium uptake by straw was much more and significant as compared to without VAM inoculant.

Total uptake of potassium by different dose of fertilizers and fungal inoculants was significant and they vary from 0.425 mg/pot in control to 0.503 mg/pot in VAM treatment T<sub>7</sub> (N<sub>1/2</sub> P<sub>1/2</sub> K + VAM-SIII/3) with inoculants VAM-SIII/3. The increasing dose of fertilizers has significantly increased the total potassium uptake by 3/4<sup>th</sup> and full dose of fertilizer over control.

#### CONCLUSION

Vesicular arbuscular mycorrhizal fungi increase the physiological activity of root system of plants and help in uptake of N, P, K nutrients and water. They have efficient enzyme system which breaks down complex organic substances into similar forms which are then absorbed by root

system of VAM-infected plants. Conclusively our findings suggested that the use of VAM may be a boon for the farmers which are destined to grow cereal.

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