



Research Article

## Effect of different levels and sources of phosphorus with and without pressmud and PSM on yield, quality and pod uprooting in groundnut crop

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**Abstract :** Field experiment was conducted at Navsari Agricultural University, Navsari (Gujarat) during summer seasons of 2002 and 2003 to study the effect of different levels and sources of phosphorus with and without pressmud and PSM (Phosphorus solubilising micro-organism) on yield, quality and pod uprooting. An application of 15 kg P from SSP+5t pressmud + 2.5 kg PSM ha<sup>-1</sup> producing highest pod, haulm yield and protein content. Whereas application of 10t pressmud results higher per cent pods lifted with plant<sup>-1</sup>.

**Key Words :** Groundnut, Phosphorus, Pod uprooting

**How to cite this Article:** Kausale, S.P., Shinde, S.B. and Patel, C.L (2011). Effect of different levels and sources of phosphorus with and without pressmud and PSM on yield, quality and pod uprooting in groundnut crop, *Internat. J. Forestry & Crop Improv.*, 2 (2) : 110-113.

**Article Chronical :** Received : 15.03.2011; Revised : 22.06.2011; Accepted : 20.09.2011

### INTRODUCTION

True to the same unpredictable legume it is difficult to decide the yield of groundnut. Harvesting method of groundnut crop is very much difficult on heavy soil than lighter type of soil. At the time of harvesting groundnut plant is uprooted, at that time all pods are not 100 per cent uprooted. This may be due to soil condition compaction, wet/dry condition of soil, plant type, depth of pod in soil and strength of peg (gynophores). Pods remain in soil after uprooting, this may leads to reduction in yield. Pod left in soil is very difficult to collect and very costly (not profitable). Soil compaction is one of the main reasons for pod remains in soil. To reduce this compaction organic matter (pressmud) is added in soil. Organic matter decreases bulk

density, decreases soil compaction, increases per cent pore, increases water holding capacity which is used full for crop growth and at the time of harvesting of groundnut crop. Thus, experiment was take to study how much per cent pods remaining in soil of groundnut crop under Vertisol soil south Gujarat conditions.

### EXPERIMENTAL METHODS

An experiment was laid out during summer seasons of 2002 and 2003 at University Farm, Navsari Agricultural University, Navsari. In this experimental plot, soil had organic carbon 3.9 g kg<sup>-1</sup>, available N 237 kg ha<sup>-1</sup>, available P 8.44 kg ha<sup>-1</sup> and available K 287.18 kg ha<sup>-1</sup> with pH of 8.0. Treatments were replicated three times in Randomized Block Design. Treatments were : T<sub>1</sub>-2.5 kg PSM ha<sup>-1</sup>, T<sub>2</sub>-5 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>3</sub>-10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>4</sub>-15 kg P ha<sup>-1</sup> from DAP + 2.5 kg PSM ha<sup>-1</sup>, T<sub>5</sub>-15 kg P ha<sup>-1</sup> from SSP + 2.5 kg PSM ha<sup>-1</sup>, T<sub>6</sub>-30 kg P ha<sup>-1</sup> from DAP + 2.5 kg PSM ha<sup>-1</sup>, T<sub>7</sub>-30 kg P ha<sup>-1</sup> from SSP + 2.5 kg PSM ha<sup>-1</sup>, T<sub>8</sub>-15 kg P ha<sup>-1</sup> from DAP + 5 t pressmud + 2.5 kg PSM ha<sup>-1</sup>, T<sub>9</sub>-15 kg P ha<sup>-1</sup> from SSP + 5 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>10</sub>-

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15 kg P ha<sup>-1</sup> from DAP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>11</sub>-15 kg P ha<sup>-1</sup> from SSP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>12</sub>-30 kg P ha<sup>-1</sup> from DAP + 5 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>13</sub>-30 kg P ha<sup>-1</sup> from DAP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>14</sub>-30 kg P ha<sup>-1</sup> from DAP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>, T<sub>15</sub>-30 kg P ha<sup>-1</sup> from SSP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>. Nitrogen @ kg ha<sup>-1</sup> was applied through urea in all treatments and this dose was adjusted in DAP treatment. P was applied as per treatments, pressmud and PSM were uniformly placed as per the treatments at the time of sowing as basal dose. Groundnut variety GG-2 was sown in rows spaced 30 cm apart with inter row spacing of 10 cm during January and harvested in May during both the years. The crop received irrigation whenever necessary. The response function of P (sources and levels) with or without pressmud (5 and 10 t ha<sup>-1</sup>) PSM were studied for two years of experimentation. The sample during second year was conducted on same site of first year.

#### Per cent pods lifted with plant :

The sample plants were lifted from one m<sup>-2</sup>, number of pod lifted were counted and number of pods coming up with plant by digging from one m<sup>-2</sup> were also recorded. Per cent pods lifted were calculated by using following formula:

$$\text{Per cent pods lifted with plant} = \frac{\text{Pods lifted with plant by uprooting}}{\text{Pods come with plant by digging}} \times 100$$

#### Per cent pods remaining in soil :

Per cent pods remaining in soil was calculated by using following formula :

$$\text{Pods remain} = \frac{\text{Pods coming up with plant by digging} - \text{Pods coming up with lifting (uprooting) the plants}}{\text{Pods coming up with plant by digging}} \times 100 \text{ in soil (\%)}$$

## EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been presented under following heads :

#### Pod, haulm yield and harvest index:

Pod and haulm yield ha<sup>-1</sup> of groundnut (Table 1) were increased significantly due to application of 30 kg P ha<sup>-1</sup> from SSP + 5 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup> (T<sub>13</sub>) and statistically at par with treatments T<sub>11</sub>, T<sub>15</sub>, T<sub>14</sub>, T<sub>10</sub> and T<sub>9</sub> in

**Table 1 : Pod, haulm yield and harvest index of groundnut influenced by phosphorus managements**

Treatments	Pod yield (kg ha <sup>-1</sup> )			Haulm yield (kg ha <sup>-1</sup> )			Harvest index (%)	
	2002	2003	Pooled	2002	2003	Pooled	2002	2003
T <sub>1</sub>	1342.95	1479.42	1411.18	3051.98	3133.54	3092.76	30.09	31.12
T <sub>2</sub>	1638.03	1744.11	1691.07	3600.30	3664.67	3632.48	31.02	32.27
T <sub>3</sub>	2320.91	2487.69	2404.30	4642.89	4827.35	4735.12	33.33	34.00
T <sub>4</sub>	1763.07	1928.29	1845.68	3643.12	3724.76	3683.94	32.68	34.21
T <sub>5</sub>	1815.22	1960.53	1887.88	3732.23	3871.75	3801.99	32.71	33.65
T <sub>6</sub>	2174.23	2329.52	2251.87	4406.94	4522.40	4464.67	33.00	33.95
T <sub>7</sub>	2269.78	2420.03	2344.90	4639.13	4721.80	4680.47	32.83	33.89
T <sub>8</sub>	2330.93	2512.99	2421.96	4689.65	4847.07	4768.36	33.18	34.14
T <sub>9</sub>	2534.68	2686.41	2610.55	4899.62	5016.17	4957.90	34.17	34.83
T <sub>0</sub>	2567.62	2778.86	2673.24	5109.27	5204.19	5156.73	33.44	34.73
T <sub>11</sub>	2663.74	2905.05	2784.40	5399.97	5508.22	5454.10	33.10	34.52
T <sub>12</sub>	2611.10	2816.05	2713.57	5132.17	5302.35	5217.26	33.74	34.67
T <sub>13</sub>	2754.35	2999.00	2876.68	5501.25	5736.00	5618.63	33.35	34.94
T <sub>14</sub>	2545.28	2738.45	2641.86	5022.21	5155.27	5088.74	33.66	34.61
T <sub>15</sub>	2634.74	2886.84	2760.79	5321.80	5420.67	5366.74	33.82	34.65
S.E.±	135.11	163.98	150.24	246.78	281.07	264.48	1.99	2.05
C.D. (P=0.05)	391.30	474.94	425.83	714.75	814.05	749.63	NS	NS
C.V. %	10.33	11.62	11.05	9.32	10.34	9.86	10.46	10.46
G.M.	2264.40	2444.90	2354.65	4585.60	4710.40	4648.00	32.94	34.01

NS=Non-significant

respect of pod and haulm yield ha<sup>-1</sup> during both the years and in pooled data of the experimentation. Similar findings were also reported by Ramesh and Sabale (2001).

In this experiment the interesting matter noted was that SSP source perform better than DAP in all growth and yield attributing characters, pod and haulm yield ha<sup>-1</sup>. However, at each equal dose of phosphorus (SSP and DAP) source, the treatment differences were non significant. The better performance of SSP than DAP may be attributed to presence of nearly 50 per cent CaSO<sub>4</sub>.2H<sub>2</sub>O, which supplied Ca and S to the crop during the growth period. Ca and S are essential nutrient for better yield and qualities of groundnut. Single super phosphate acts as a preservative and prevents volatilization of gases including ammonia. Simultaneously P<sub>2</sub>O<sub>5</sub> is not fixed in the soil and is interlocked with the organic matter and thus, become easily available for plant growth. Second interesting finding was at higher dose of phosphorus managements, there was reduction in yield attributes, pod and haulm yield ha<sup>-1</sup>. Tomar *et al.* (1983) also ascribed the toxic effect of excessive application of phosphorus beyond the super normal range of requirement, which have resulted decrease in yield and yield attributes. The yield increased upto a certain dose, beyond which the phosphorus manuring became uneconomical and in some case caused reduction in the yield occurs. Similar findings were also reported by Vasisth and Pandey (1999).

The effect of phosphorus management on harvest index was though non-significant during both the years but it was comparatively improved the to phosphorus managements.

#### Pod lifted with plant<sup>-1</sup> :

Per cent pod lifted with plant<sup>-1</sup> was relatively higher during 2<sup>nd</sup> year of study than that of first year of experimentation (Table 2). Phosphorus managements markedly influenced the per cent lifted with plant<sup>-1</sup> of groundnut during both the years. Significantly the higher per cent pod lifted with plant<sup>-1</sup> were noted with treatment T<sub>14</sub> (30 kg P ha<sup>-1</sup> from DAP + 10 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup>) during 2002, but did not differ with treatments T<sub>10</sub>, T<sub>15</sub> and T<sub>11</sub>. During 2003 crop season treatment T<sub>10</sub> (15 kg P ha<sup>-1</sup> from DAP + 10 t pressmud ha<sup>-1</sup> + 25 kg PSM ha<sup>-1</sup>) recorded significantly higher per cent pod lifted with plant<sup>-1</sup> and was remained at par with treatments T<sub>15</sub>, T<sub>14</sub>, T<sub>13</sub>, T<sub>12</sub>, T<sub>9</sub>, T<sub>11</sub>, T<sub>2</sub> and T<sub>8</sub>.

Significantly the lowest per cent pod lifted with plant<sup>-1</sup> was recorded in treatment T<sub>7</sub> (30 kg P ha<sup>-1</sup> from SSP + 2.5 kg PSM ha<sup>-1</sup>), however, statistically it did not differ with all other treatments except treatment T<sub>3</sub>, T<sub>10</sub>, T<sub>11</sub>, T<sub>14</sub>, T<sub>15</sub> during 2002 crop season. Treatment T<sub>1</sub> recorded the lowest per cent lifted with plant<sup>-1</sup> during 2003 and was found at par

**Table 2 : Per cent pod lifted plant<sup>-1</sup> and per cent remain in soil and total number of pods plant<sup>-1</sup> of groundnut as influenced by phosphorus managements**

Treatments	Per cent pod lifted plant <sup>-1</sup>		Per cent rod remain in soil	
	2002	2003	2002	2003
T <sub>1</sub>	83.33	81.41	16.67	18.59
T <sub>2</sub>	87.29	86.51	12.71	3.49
T <sub>3</sub>	95.45	97.74	4.55	2.26
T <sub>4</sub>	84.68	85.10	15.32	14.90
T <sub>5</sub>	84.87	84.21	15.13	15.79
T <sub>6</sub>	83.62	86.59	16.38	13.41
T <sub>7</sub>	82.82	82.60	17.18	17.40
T <sub>8</sub>	85.81	95.45	14.19	4.55
T <sub>9</sub>	86.92	97.31	13.08	2.69
T <sub>0</sub>	95.98	98.51	4.02	1.49
T <sub>11</sub>	95.13	96.90	4.87	3.10
T <sub>12</sub>	86.88	97.47	13.12	2.53
T <sub>13</sub>	86.91	97.25	13.09	2.75
T <sub>14</sub>	96.13	97.75	3.87	2.25
T <sub>15</sub>	95.46	98.25	4.54	1.75
S.E.±	2.04	1.92	2.04	1.92
C.D. (P=0.05)	5.92	5.57	5.92	5.57
C.V. %	3.99	3.59	31.47	46.73
G.M.	88.75	92.87	11.25	7.13

with treatments T<sub>7</sub>, T<sub>5</sub>, T<sub>4</sub> and T<sub>6</sub>.

#### Pod remain in soil :

Pod per cent remain in soil was relatively lower during 2003 than that of 2002, under the condition of present experiment (Table 2). Phosphorus managements exerted significant effect on per cent pod remained in soil of groundnut during both the years of study. Significantly the highest per cent pod remain in soil were noticed with treatment T<sub>7</sub> (30 kg P ha<sup>-1</sup> from SSP + 2.5 kg PSM ha<sup>-1</sup>) during 2002, however, it was at par with all other treatments except T<sub>3</sub>, T<sub>10</sub>, T<sub>11</sub>, T<sub>14</sub> and T<sub>15</sub>. During 2003 crop season highest per cent pod were remained in soil under treatment T<sub>1</sub> and was at par with treatments T<sub>7</sub>, T<sub>5</sub>, T<sub>4</sub> and T<sub>6</sub>.

Significantly the lowest per cent pod remain in soil water recorded in treatment T<sub>14</sub> during 2002 crop season and was at par with treatments T<sub>10</sub>, T<sub>15</sub>, T<sub>3</sub> and T<sub>4</sub>. Similarly, T<sub>10</sub> recorded lowest per cent and with treatments T<sub>10</sub>, T<sub>15</sub>, T<sub>13</sub> and T<sub>4</sub>. Similarly, T<sub>10</sub> recorded lowest per cent pod remain in soil during 2003 crop season and was at par with all other treatments except T<sub>1</sub>, T<sub>4</sub> to T<sub>7</sub>, T<sub>14</sub>.

Significantly the higher per cent pod lifted with plant<sup>-1</sup> were observed in treatment which received 10 t pressmud ha<sup>-1</sup> during first year while in case of second year higher per

**Table 3 : Protein content in kernel, haulm and oil content in kernel of groundnut as influenced by phosphorus managements**

Treatments	Protein content in kernel (%)		Protein content in haum (%)		Oil content in kernel (%)	
	2002	2003	2002	2003	2002	2003
T <sub>1</sub>	18.13	18.48	9.05	8.94	49.32	49.52
T <sub>2</sub>	19.57	19.65	9.17	9.33	49.02	49.16
T <sub>3</sub>	20.33	20.70	9.17	9.15	49.67	49.57
T <sub>4</sub>	19.56	19.66	9.10	9.03	49.89	49.72
T <sub>5</sub>	19.75	19.82	9.04	9.08	49.88	49.92
T <sub>6</sub>	19.92	20.06	9.10	9.13	49.91	49.93
T <sub>7</sub>	20.13	20.60	9.15	9.31	49.85	49.79
T <sub>8</sub>	20.73	21.39	9.18	9.20	49.16	50.03
T <sub>9</sub>	21.50	21.96	9.28	9.37	50.35	50.16
T <sub>0</sub>	21.63	21.79	9.27	9.22	50.33	50.57
T <sub>11</sub>	21.85	22.19	9.23	9.29	51.34	51.68
T <sub>12</sub>	21.65	21.85	9.21	9.29	51.49	51.58
T <sub>13</sub>	21.67	21.94	9.25	9.14	51.32	51.49
T <sub>14</sub>	21.52	21.73	9.40	9.18	51.03	51.32
T <sub>15</sub>	21.79	22.04	9.19	9.16	51.78	51.83
S.E.±	0.39	0.37	0.09	9.15	3.37	4.03
C.D. (P=0.05)	1.13	1.07	NS	NS	NS	NS
C.V. %	3.27	3.06	1.78	2.88	4.35	4.89
G.M.	20.65	20.92	9.19	9.19	50.29	50.42

NS=Non-significant

cent pod lifted with plant<sup>-1</sup> were observed under treatments receiving 5/10 t pressmud ha<sup>-1</sup>. Similarly the reverse trend of higher per cent pod remain in soil were observed under treatments where no pressmud was applied. This may be due to application of pressmud, improves the physical properties of soil (loosing of soil, reduction in bulk density). Increase in water holding capacity, helped in easy pods lifting at the time of harvesting. In second year higher per cent pod lifted up with both the levels of pressmud may be due to cumulative effect of pressmud as the experiments were conducted on same site during second year of study.

#### Oil content :

Phosphorus managements failed to influence significantly the oil content in groundnut kernel during both the individual years of study (Table 3). However, the higher oil content was recorded in treatment T<sub>15</sub> during both the years.

#### Protein content :

Phosphorus managements significantly increased the protein content in kernel, whereas failed to exert significant difference in haulm during both the years of study (Table 3).

The protein content in kernel was higher with treatment T<sub>13</sub>, but was found at par with treatments T<sub>11</sub>, T<sub>15</sub>, T<sub>10</sub>, T<sub>12</sub>, T<sub>14</sub> and T<sub>9</sub> during both the years of study. It also remained at

par with treatment T<sub>8</sub> during 2003 crop season. The lowest protein content in kernel was recorded in treatment 2.5 kg PSM ha<sup>-1</sup> only (T<sub>1</sub>).

From the above results, it can be concluded that for summer groundnut crop in South Gujarat condition, farmers should apply 15 kg P ha<sup>-1</sup> from SSP + 5 t pressmud ha<sup>-1</sup> + 2.5 kg PSM ha<sup>-1</sup> for getting higher pod, haulm yield and protein content. For better pod uprooted from black soil farmer should apply 10 t pressmud ha<sup>-1</sup> during each year.

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