Original Research Article

COMPARATIVE STUDY OF NUTRIENT RELEASE PATTERN FROM NUTRIPELLET PACK AND POLYCOAT PAPER ENCAPSULATED FERTILIZER PACK PLACED IN SOILS

ABSTRACT:

Nutripellet pack is a tubular assembly composed of fertilizer pellet, manure pellet and bioinoculants. A laboratory electrolyte release study was conducted to assess the extent of nutrient enrichment by nutrient release from encapsulated fertilizer pellet. Nutripellet pack and fertilizer pellet pack was placed in soil, within a closed container. Periodically the entire soil was removed for the estimation of soil reaction (pH), electrical conductivity (EC) and available forms of N, P and K up to 11 weeks after incubation (WAI). Before the analysis the residual encapsulated pellet was removed. The treatments comprising the sources of fertilizers (N for urea, P for DAP or SSP and K for MOP), levels of nutrient release pore (0, 25 micro pores) in fertilizer pellet and Nutripellet pack (fertilizer pellet + manure pellet) placement in sand, red soil and hill soil. High available N observed with Nutripellet pack with NP(DAP)K was 201 mg at 5th week in sand, 518 mg at 6th week in red soil and 964 mg at 8th week in hill soil. Available P with NP(DAP)K showed 87.9 mg at 7th week in sand, 64.0 mg at 9th week in red soil and 111 mg at 8th week in hill soil. Available K estimated with NP(DAP)K was 249 mg at 2nd week in sand, 233 mg at 4th week in red soil and 211 mg at 9th week in hill soil.

Comment [Reviewer1]: What's the wider conclusion of your experiment in the real worlds?

KEY Words: Nutrient release, Nutripellet pack, Fertilizer pack, Comparison and available macro nutrients

Introduction

Placement of nutrients and fertilizer rates are important factors to be considered to produce maximum yield of crops. Particularly deep placement of nutrients might be beneficial to crop growth. Increased early growth has been observed with deeper P placement as well as by deep band placement of K when compared to broadcast application (**reference?**). The method of N, P and K deep placement has typically been found effective

Comment [Reviewer2]: Ref

over broadcasting on the top of the soil, and it is also influenced by the amount of water used for irrigation. Normally fertilizers are broadcasted. Many a times, straight fertilizers are used as the source of nutrients. In order to manage the losses with these highly soluble fertilizers split application is recommended, particularly for urea. Nutriseed Pack Technique is a new development in the Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University (TNAU), Coimbatore (reference/details). Normally fertilizers are broadcasted in crop fields and straight fertilizers are used as the source of nutrients. Under surface application the fertilizer use efficiency is low. In this situation Nutriseed Pack technique helps in improving the efficiency and yield (Ref). Each Nutriseed Pack contains seed at top, enriched manure in the middle and encapsulated fertilizer at bottom. By placing a Nutriseed Pack vertically or horizontally in soil, each plant can be established. Nutriseed Pack gives support for each plant in the root zone in terms of optimum nutrient supply, biological activity, release of pesticide, etc. and consequently enables the fullest utilization of nutrients by plants. There is no wastage of fertilizer nutrients with Nutriseed Packs.

Comment [Reviewer3]:

Comment [Reviewer4]: Describe about the technique with a schematic diagram about the Nutriseed pack

Comment [Reviewer5]: Give a reference from the previous research

Comment [Reviewer6]: Where does the pesticide come from?

Fertilizer pellet from machine | Temporary storage | Sealed packets

Manure pellets | After adding encapsulated fertilizer & manure pellet

Addition of bioinoculants & pasting | Nutripellet Packs ready for carnation field

Image 1:

Effect of Nutriseed Pack Placement In early research on deep placement using Nutriseed Pack resulted in the grain yield increase to tune of 81.8 per cent over surface broadcast (Asha and Arulmozhiselvan, 2006). Vengatesan (2007) reported spectacular increase in maize grain yield for 100% NPK Nutriseed Pack to the tune of 55.9, 37.9, and 14.2 per cent over surface broadcast of fertilizers under surface, micro sprinkler and drip irrigation respectively. Radhika (2010) reported that Nutriseed Pack with Furadan resulted in the highest grain yield of 5290 kg ha^{-1} under surface irrigation, which was 832 kg higher than surface broadcast; and of 4489 kg ha^{-1} under drip irrigation, which was 525 kg higher than surface broadcast. Placement of Nutriseed Pack with 125% NPK was comparable to 100% NPK Nutriseed Pack with Neem, Furadan, manure + fertilizer mixture indicating a saving of 25% N, both under surface and drip irrigation. Aaron (2011) experimented with Nutriseed

Comment [Reviewer7]: Remove adjectives from the script; you can say significant

Comment [Reviewer8]: Is this 100% Recommended Dosage of Fertilizer?

Comment [Reviewer9]: maximum

Comment [Reviewer10]: more

Comment [Reviewer11]: 125% of RDF?

Pack treatments and reported higher curd yield of cauliflower for Nutriseed Pack placement when compared to surface broadcast. Nutriseed Pack with Phorate resulted in the highest curd yield of 28.8 t ha^{-1}, which was 8.22t ha^{-1} higher than surface broadcast. In Nutriseed Pack placement, application of bioinoculants, enriched manure and fertilizers were done in the field in a single attempt. Below the seedling, the nutrients were placed.

Muthukrishnan and Arulmozhiselvan (2013) recorded the response for Nutripellet pack placement on marigold yield and its components. The results of the experiment indicated that 100% NPK Nutripellet pack recorded the highest flower yield of 45.5 t ha^{-1} which was 98.8% higher than surface broadcast. On an average, Nutripellet pack with DAP recorded flower weight, petal-calyx ratio, and number of petals per flower.

Comment [Reviewer12]: How much?

Kalaiselvi and Arulmozhiselvan (2013) evaluated Nutriseed Pack technique for enhancement of maize yield under drip irrigation. The results revealed that Nutriseed Pack with different pesticides registered remarkably high grain yield of maize which ranged from 6983 to 7345 kg ha^{-1}, followed by the conventional surface fertilizer application which recorded moderate yield of 6558 kg ha^{-1}. The highest grain yields of 7236 and 7345 kg ha^{-1} recorded with Nutriseed Pack containing carbofuran under horizontal and vertical placement which were 10.3 and 12.0 per cent higher than conventional surface fertilizer application, respectively. Both placement methods were equally effective. Practically, horizontal placement was found to be easier in field than the vertical placement.

Comment [Reviewer13]: How; In terms of application?

Surabhi Hota and Arulmozhiselvan (2016) reported that by Nutriseed Pack placement, because of increased fertilizer use efficiency, 50% fertilizer NPK can be saved when compared to 100% NPK blanket dose prescribed for conventional surface broadcast method of fertilizer application in tomato crop.

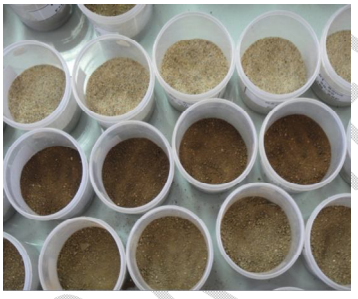
MATERIALS AND METHODS:

In this present experiment, transparent circular plastic container (500ml) was used. For placing fertilizer pellet pack or Nutripellet Pack (fertilizer pellet pack + manure pellet), initially inside the container 100 g soil was filled. Then the pellet pack was positioned vertically at the centre and filled around and on top with another 100 g of soil. By placing each fertilizer pellet pack 4500 mg of N, 255 mg of P and 484 mg of K were added in each container.

Experimental view

Addition of soil media

Nutripellet pack placement



Sand, red and hill soil filled container

Addition of water to maintain 75% WHC

Incubated containers

Image 2: Nutrient release study from fertilizer pack placed in sand, red and hill soil

Comment [Reviewer14]: Label the images individually as 2A, 2B, 2C.....and refer in the text similar code

After the imposition of treatments, 40 ml of distilled water was added to each container to maintain moisture at about 50 per cent water holding capacity. The top of container had screw threads for capping with lid tightly without air leakage to reduce evaporation. At the time of sampling, the wet soil was mixed thoroughly with glass rod, and sampled for available N, P and K estimation. The results were computed by adjusting moisture and expressed on dry weight basis.

Chart 1 : Treatment details

T. No	Treatment	Details	
		Weight on Needle (g)	No. of Micropores
T_1	FPP with NP(DAP)K	0 Pressure	0 Micropore
T_2	FPP with NP(SSP)K	0 Pressure	0 Micropore
T_3	FPP (porous) with NP(DAP)K	25 Pressure	25 Micropore
T_4	FPP (porous) with NP(SSP)K	25 Pressure	25 Micropore
T_5	NPP with NP(DAP)K	0 Pressure	0 Micropore
T_6	NPP with NP(SSP)K	0 Pressure	0 Micropore
T_7	NPP (porous) with NP(DAP)K	25 Pressure	25 Micropore
T_8	NPP (porous)with NP(SSP)K	25 Pressure	25 Micropore

FPP - Fertilizer pellet pack NPP - Nutripellet Pack

Fertilizer pellet - contains urea, SSP or DAP and muriate of potash

Nutripellet Pack – contains fertilizer pellet + manure pellet and bioinoculants

Pressure – refers to weight of material placed upright on top of needle

Micro pore refers to number of pores made by needle assembly.

Applying needle pressure on paper surface

Micropuncturing tool

Period of estimation and expression of results

Analysis of soil sample was done at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 weeks after placement of based on soil moisture adjustment, the results of soil nutrient analysis were expressed on dry weight basis.

RESULT AND DISCUSSION

In the present study release of nutrients were estimated upto 11 weeks of incubation. When a fertilizer pellet encapsulated with polycoat paper is placed near to roots of a plant, it is the requirement to assess the concentration of nutrients and change in physico-chemical properties in the root zone soil, so that the deleterious or favourable effects of encapsulation can be found. Accordingly, in small volume of soil encapsulated fertilizer pellet was placed and the impact of nutrients diffused out of encapsulation were assessed in terms of change in available N, P and K and physico-chemical properties at weekly intervals, simulating the root zone soil, however without crop.

When an encapsulated fertilizer pellet was placed in soil, the nutrient ions liberated through polycoat paper caused conspicuous variation in the pH with advancement of periods (Table 5). In spite of variation in source of nutrients, presence of micropores and presence of manure pellet there was ~~an~~ a uniform trend in change in pH with time.

Soil reaction (pH) (Table 5)

In sand, among the treatments, pH ranged from 6.22 in Nutripellet Pack (porous) with NP(SSP)K on 11th WAI to 9.09 in fertilizer pellet pack with NP(DAP)K on 4th WAI. Among the periods, pH varied from 6.68 on 8th WAI to 8.70 on 4th WAI.

Among the treatments, pH was higher in fertilizer pellet pack with NP(DAP)K (8.01), which was on par with fertilizer pellet pack (porous) with NP(DAP)K, whereas other treatments did not show significant differences among themselves. In the treatments of fertilizer pellet pack with or without pores containing SSP or DAP pH increased in 4th WAI and decreased in 8th WAI, thereafter increased in 10th WAI. In the case of Nutripellet pack with or without pores containing SSP or DAP pH value deeply decreased in 8th WAI. pH was alkaline from 1st to 5th WAI thereafter became neutral from 6th to 9th WAI then again increased on 10th WAI and again decreased to near neutral pH.

Comment [Reviewer15]: May be a better word?

In red soil, within the treatments, pH ranged from 6.53 in Nutripellet pack with NP(SSP)K in 8th WAI to 9.31 in fertilizer pellet pack with NP(SSP)K on 4th WAI. There was no significant difference among the treatments. Among the periods, pH varied from 7.02 in 8th WAI to 8.78in 5th WAI.

With treatments involving with or without pores of fertilizer pellet pack containing SSP or DAP pH increased in 4th WAI and deceased in 8th WAI thereafter increased in 10th WAI. With Nutripellet pack with or without pores containing SSP or DAP pH deeply

decreased in 8th WAI. pH was alkaline from 1st to 6th WAI thereafter maintained neutral from 7th to 9th WAI then again increased in 10th WAI and later decreased to neutral pH.

In hill soil, with every treatment, pH ranged from 5.59 in Nutripellet pack with NP(SSP)K in 9th WAI to 9.50 in Nutripellet pack with NP(SSP)K in 4th WAI. Among the periods, pH varied from 7.07 in 9th WAI to 8.88 in 7th WAI.

Among the treatments, pH was higher in fertilizer pellet pack NP(DAP)K and Nutripellet pack NP(DAP)K with or without pores, whereas SSP containing fertilizer pellet pack and Nutripellet pack recorded the lowest pH values. In treatments with or without pores of fertilizer pellet pack containing SSP or DAP, the pH value increased in 4th WAI and deceased in 8th WAI thereafter increased in 10th WAI. Similarly Nutripellet pack with or without pores containing SSP or DAP, pH value deeply decreased in 8th WAI. pH was alkaline in 1st to 7th WAI thereafter neutral condition was maintained during 8th and 9th WAI then again increased in 10th WAI and decreased to neutral pH.

During the period from 1 to 7 weeks the pH remained alkaline, thereafter pH changed to acidic and then changed to near neutral after 9 weeks. Subsequent to placement of fertilizer, soil becoming alkaline could be attributed to the release of ammonium compounds from DAP or from hydrolyzing urea.

Comment [Reviewer16]: Rephrase the sentence?

As long as release of ammonium compounds was happening in soil, pH increased and remained in alkaline range. In sand, red soil and hill soil the peak pH of 9 to 9.5 was attained at the end of 4 weeks. Thereafter pH declined slowly to neutral and then to acidic range. High acidity of 6 to 6.5 pH was attained at 8 weeks of incubation in sand and red soil, whereas in hill soil at 9 weeks of incubation.

The causes of reduction in pH reaching the acidic range during 6 to 8 weeks of incubation could be possibly due to nitrification. When localized accumulation of ammonium compounds occurred pH could have been raised to alkaline range, which might have inhibited microbial activity. With prolonged time ammonium compounds might have dissolved in soil water and dissociated to give ammonium ions. In red soil and hill soil having active clay, majority of ammonium ions might have been fixed on exchange surfaces of clay thereby reducing ammonium concentration in solution.

With resultant reduced concentration of ammonium, nitrifying bacteria might have become active. Nitrification is oxidation processes which generally produce hydrogen ion as one of the products. As ammonium ions are subject to oxidation, nitrate ions are formed,

Comment [Reviewer17]: All the explanations and claims have to be supported with the literature. Or you may have to say “we assume/speculate” etc.

releasing two hydrogen ions for each ammonium ion oxidized. Due to release of these hydrogen ions a strong acidic pH might have resulted in soil solution.

Subsequent to the result of high acidic pH, again the soil pH attained to neutrality, probably due to further release of ammonium compounds from the encapsulated fertilizer pellet, which would have raised the pH. Thus, undulation and stabilization to original pH could be expected for a prolonged duration beyond 11 weeks. Balancing of pH due to ammonification, ammonia volatilization, ammonium fixation and nitrification was smooth in sand and slightly vitiating in red soil. In hill soil, due to the presence of low active clay and low activity of bacteria pH lines observed were turbulent.

Comment [Reviewer18]: Biologically active?

Electrical conductivity (EC) (Table 6)

In sand, among the treatments, EC varied from 0.09 dS m^{-1} in fertilizer pellet pack with NP(SSP)K in 1st week after incubation (WAI) to 8.52 dS m^{-1} in fertilizer pellet pack (porous) with NP(DAP)K in 7th WAI. With weeks of incubation EC ranged from 0.70 dS m^{-1} in 1st WAI to 4.31 dS m^{-1} in 7th WAI.

Within the treatments, EC measured with Nutripellet pack (porous) with NP(DAP)K was high (4.73 dS m^{-1}) followed by fertilizer pellet pack (porous) with NP(DAP)K (4.51 d Sm^{-1}). Moderate EC was observed in fertilizer pellet pack with NP(DAP)K, Nutripellet pack with NP(DAP)K, Nutripellet pack (porous) with NP(SSP)K and fertilizer pellet pack (porous) with NP(SSP)K, recording values up to 3.45 dS m^{-1}. Low EC was observed in Nutripellet pack with NP(SSP)K (1.30 dS m^{-1}). The lowest EC was recorded in fertilizer pellet pack with NP(SSP)K (0.78 dS m^{-1}).

In red soil, among the treatments, EC ranged from 0.08 dS m^{-1}in fertilizer pellet pack with NP(DAP)K in 1st WAI to 8.19 dS m-1 in Nutripellet pack (porous) with NP(SSP)K in 7th WAI. Among the periods EC varied from 0.71 dS m^{-1} on 1st WAI to 5.88 dS m^{-1} on 7th WAI.

Among the treatments, fertilizer pellet pack with NP(SSP)K recorded lower EC of 1.36 dS m^{-1}, whereas higher EC was registered in Nutripellet pack (porous) with NP(DAP)K (5.55 dS m^{-1}) followed by Nutripellet pack (porous) with NP(SSP)K (5.28dS m^{-1}), the other treatments recorded moderate EC recording values up to 4.91 dS m^{-1}.

In hill soil, among the treatments, EC varied from 0.19 dS m^{-1} in fertilizer pellet pack with NP(SSP)K on 3rd WAI to 12.08 dS m^{-1} in fertilizer pellet pack with NP(DAP)K on 7th WAI. With weeks of incubation EC ranged from 1.85 dS m^{-1}in 1st WAI to 7.88 dS m^{-1} on 7th WAI.

The highest EC was observed in Nutripellet pack (porous) with NP(DAP)K (6.63 dS m^{-1}), whereas moderate EC was found with fertilizer pellet pack (porous) with NP(DAP)K, fertilizer pellet pack with NP(DAP)K, Nutripellet pack (porous) with NP(SSP)K, recording values up to 6.20 dS m^{-1}. The treatment involving fertilizer pellet pack (porous) with NP(SSP)K and fertilizer pellet pack with NP(SSP)K recorded low EC up to 4.15 dSm^{-1}. A very low EC was observed in fertilizer pellet pack with NP(SSP)K (1.18 dS m^{-1}). Among the soil types, EC was high in hill soil (6.63 dS m^{-1}) followed by red soil (5.55 dS m^{-1}) and sand (4.73 dSm^{-1}).

Electrical conductivity measured at weekly intervals exhibited smooth trends for fertilizer packs having no micropores in the polycoat paper encapsulation. When micropores were provided in polycoat paper EC (in dS m^{-1}) fluctuated between 4 and 8, which could be on the other hand a limiting salinity factor for plant growth, at the root zone. Even with polycoat paper without micopores, EC was higher with NP(DAP)K than with NP(SSP)K pellets.

Available nitrogen (mg)

In sand, among the treatments, soil available N varied from 2.10 mg (per container) in fertilizer pellet pack with NP(DAP)K in 1st WAI to 476.0 mg in Nutripellet pack (porous) with NP(SSP)K in 9th WAI. Within weeks of incubation, available N ranged from 15.4 mg in 1st to 204.7 mg in 9th WAI. Among the weeks of incubation, available N increased with increase in weeks of incubation up to 2nd WAI (60.4 mg) and decreased in 3rd WAI (50.0 mg), thereafter varied irregularly reaching high (204.7 mg) in 9th WAI and declined to 115.9 mg on 11th WAI (Table 3).

Within the treatments, the highest available N was observed in Nutripellet pack (porous) with NP(SSP)K, and fertilizer pellet pack (porous) with NP(DAP)K (120.3 mg), which was found on par with fertilizer pellet pack with NP(DAP)K (114.5 mg). The moderate available N was recorded in Nutripellet pack with NP(DAP)K (99.0 mg) and it was on par with fertilizer pellet pack (porous) with NP(SSP)K (63.4 mg), whereas the lowest available N was observed in Nutripellet pack with NP(SSP)K (54.40 mg) and it was comparable with fertilizer pellet pack with NP(SSP)K (49.8 mg).

In red soil, within treatments, available N ranged from 47.18 mg in Nutripellet pack with NP(DAP)K in 1st WAI to 858.20 mg in Nutripellet pack with NP(SSP)K in 4th WAI. Among the periods, available N varied from 79.07 mg on 1st WAI to 677.08 mg on 4th WAI.

With increase in weeks of incubation available N increased from 1st WAI (79.07 mg) to 4th WAI (677.08 mg) thereafter decreased and maintained up to 10th WAI and again decreased in 11th WAI.

Among the treatments, available N was very low in fertilizer pellet pack with NP(SSP)K (271.3 mg), low N was recorded in fertilizer pellet pack (porous) with NP(SSP)K, fertilizer pellet pack with NP(DAP)K and Nutripellet pack with NP(SSP)K, recording values up to 376.0 mg. The treatment involving Nutripellet pack with NP(DAP)K was on par with Nutripellet pack (porous) with NP(SSP)K showed moderate N, recording values up to 407.4 mg. The highest N was observed in Nutripellet pack (porous) with NP(DAP)K (489.10 mg) followed by fertilizer pellet pack (porous) with NP(DAP)K (442.0 mg).

In hill soil, among the treatments, available N ranged from 168.7 mg in fertilizer pellet pack with NP(SSP)K on 1st WAI to 1078 mg in fertilizer pellet pack with NP(SSP)K on 4th WAI. Among the weeks of incubation periods, available N varied from 248.6 mg on 1st WAI to 879.2 mg on 4th WAI. Within weeks of incubation periods, available N increased with increase in weeks of incubation up to 4th WAI thereafter decreased in 6th WAI then increased on 7th WAI and maintained up to 11th WAI.

The highest amount of available N was recorded in Nutripellet pack (porous) with NP(DAP)K (745.8 mg) followed by fertilizer pellet pack (porous) with NP(DAP)K (667.9 mg), whereas moderate available N was found in Nutripellet pack with NP(DAP)K (605.3 mg) and it was on par with Nutripellet pack (porous) with NP(SSP)K (600.8 mg) followed by fertilizer pellet pack with NP(DAP)K (559.5 mg). The treatment involving fertilizer pellet pack with NP(SSP)K and Nutripellet pack with NP(SSP)K were observed to have the lowest N , recording values up to 473.6 mg.

Among the soil types, the highest available N was recorded in hill soil (745.8 mg), moderate of N in red soil (489.1 mg) and in sand lowest N was observed (120.3 mg) . The highest available N per cent was recorded in hill soil (16.57 %), moderate available N per cent in red soil (10.87 %) and sand showed the lowest N (2.67 %).

Available phosphorus (per cent)

Among the soil types, high available P was recorded in sand (74.1 mg) followed by red soil (60.4 mg) and hill soil (55.6 mg).

In sand, among the treatments, soil available P per cent ranged from 0.53 in fertilizer pellet pack with NP(SSP)K in 1st WAI to 21.83 per cent in fertilizer pellet pack (porous) with NP(DAP)K in 7th WAI. Within weeks of incubation periods, available P per cent varied from 2.07 in 1st WAI to 12.01 in 7th WAI (Fig.1). Among the periods, available P per cent increased with increase in the weeks of incubation up to 4th WAI (6.36 %) and declined in 5th WAI (4.89%) thereafter slightly increased up to 11th WAI (8.43 per cent).

Within the treatments, the highest available P per cent was recorded in fertilizer pellet pack (porous) with NP(DAP)K (12.71 %) followed by Nutripellet pack (porous) with NP(DAP)K (10.93 %) and fertilizer pellet pack with NP(DAP)K (8.77 %). Moderate available P per cent was recorded in fertilizer pellet pack (porous) with NP(SSP)K (6.33 %) followed by Nutripellet pack (porous) with NP(SSP)K (4.80 %). The treatment involving Nutripellet pack with NP(SSP)K (2.77 %) was found on par with fertilizer pellet pack with NP(SSP)K (2.33%).

In red soil, within treatments, available P per cent ranged from 0.70 per cent in Nutripellet pack with NP(SSP)K in 1st WAI to 18.16 per cent in fertilizer pellet pack (porous) with NP(DAP)K in 8th WAI. Among the periods, increase in weeks of incubation periods available P increased in 3rd WAI (5.01 %) then decreased in 5th WAI (4.50 %) and again increased stabilizing in 11th WAI (6.25 %). Over all available P varied from 0.95 per cent in 1st WAI to 10.18 per cent on 7th WAI (Fig.2).

Among the treatments, the lowest P per cent was observed in fertilizer pellet pack with NP(SSP)K (2.27 %) followed by Nutripellet pack with NP(SSP)K (3.12 %). The treatment involving fertilizer pellet pack (porous) with NP(DAP)K registered the highest per cent of available P (10.36 %) followed by Nutripellet pack (porous) with NP(DAP)K in (7.93 %) and fertilizer pellet pack with NP(DAP)K (7.01 %). Rest of the treatments recorded moderate P, recording values up to 6.68 per cent.

In hill soil, among the treatments, the soil available P per cent varied from 1.64 in fertilizer pellet pack with NP(SSP)K in 5th WAI to 20.42 per cent in Nutripellet pack with NP(SSP)K in 7th WAI. With increase in weeks of incubation with available P per cent increased from 1st WAI (3.63 %) to 7th WAI (13.52 %) thereafter decreased up to 11th WAI (7.98 %). Altogether available P per cent ranged from 3.63 per cent in 1st WAI to 13.52 per cent in 7th WAI.

The treatment involving fertilizer pellet pack (porous) with NP(DAP)K showed the highest available P per cent (9.54 %), whereas the lowest available P per cent was recorded in Nutripellet pack with NP(SSP)K on 5.57 followed by Nutripellet pack (porous) with NP(SSP)K (5.01%) which was on par with fertilizer pellet pack with NP(SSP)K (4.72 %). Other four treatments were showed moderate available P per cent, recording values up to 8.38 per cent (Fig.3).

Among the soil types, available P per cent recorded was high in sand (12.71 %) followed by red soil (10.36 %) and sandy soil (9.54 %).

Available potassium (mg)

In sand, within the treatments, available K varied from 39.9 mg in fertilizer pellet pack with NP(SSP)K in 1st WAI to 731.6 mg in fertilizer pellet pack (porous) with NP(DAP)K in 3rd WAI. Among the periods, available K ranged from 86.3 mg on 1st WAI to 421.6 mg on 3rd WAI. With increase in weeks of incubation available K increased and was higher in earlier period of 2nd and 3rd WAI, thereafter gradually decreased in 11th WAI (Table 4).

Among the treatments, the highest available K was recorded in Nutripellet pack (porous) with NP(DAP)K (272.7 mg) and was comparable with fertilizer pellet pack (porous) with NP(DAP)K and Nutripellet pack (porous) with NP(SSP)K recording values up to 270.3. Moderate available K was observed in fertilizer pellet pack (porous) with NP(SSP)K (234.6 mg) followed by Nutripellet pack with NP(DAP)K was found on par with Nutripellet pack with NP(SSP)K, recording values up to 198.6 mg. the treatment involving fertilizer pellet pack with NP(DAP)K and fertilizer pellet pack with NP(SSP)K recorded the lowest K (179.9 mg).

In red soil, among the treatments, available K ranged from 74.7 mg in fertilizer pellet pack with NP(SSP)K on 1st WAI to 717.2 mg in fertilizer pellet pack (porous) with NP(DAP)K on 3rd WAI. Among the periods, available K varied from 113.1 mg on 1st WAI to 446.1 mg in 3rd WAI. With increase in weeks of incubation with available K increased and was higher in earlier period of 2nd and 3rd WAI thereafter gradually decreased in 11th WAI.

Among the treatments, the lowest K was observed in fertilizer pellet pack with NP(DAP)K (180.4 mg), which was on par with fertilizer pellet pack with NP(SSP)K, Nutripellet pellet pack with NP(DAP)K and Nutripellet pellet pack with NP(SSP)K, recording values up to 195.3 mg. The treatment involving fertilizer pellet pack (porous) with NP(DAP)K, fertilizer pellet pack (porous) with NP(SSP)K, Nutripellet pellet pack (porous)

with NP(DAP)K, and Nutripellet pellet pack (porous) with NP(SSP)K recorded the highest available K, recording values up to 263.7 mg.

In hill soil, available K varied from 110.6 mg in Nutripellet pack with NP(SSP)K in 2nd WAI to 772.7 mg in fertilizer pellet pack (porous) with NP(DAP)K in 2nd WAI. Among the periods, with increase in weeks of incubation available K increased and was higher in 2nd and 3rd WAI thereafter gradual decreased up to11th WAI and it was on par with other weeks after incubation. Over all available K ranged from 204.1 mg in 4th WAI to 401.8 mg on 3rd WAI.

Among the treatments, the lowest available K was recorded in Nutripellet pack with NP(SSP)K (173.9 mg) and it was comparable with Nutripellet pack with NP(DAP)K (180.1 mg) followed by fertilizer pellet pack with NP(DAP)K (197.6 mg). The highest available K was observed in fertilizer pellet pack (porous) with NP(DAP)K (283.4 mg). Which was on par with fertilizer pellet pack (porous) NP(SSP)K and Nutripellet pack (porous) with NP(DAP)K, recording values up to 279.6 mg. The rest of treatments showed moderate available K, recording values up to 243.0 mg.

Among the soil types, the highest available K was recorded in hill soil (283.4 mg). Moderate of available K was found in sand (272.7 mg) and the lowest in red soil (263.7 mg).

These results indicated that, to be used as barrier layer to encapsulate fertilizer pellet, polycoat paper without micropores was much suitable to impart smooth, slow and steady release of nutrients. With NP(DAP)K pellet more electrolytes were released in outer solution which could be due to the result of permissibility of polycoat paper for solution as well as for gaseous ammonia.

Fertilizer pellets made as NP(SSP)K and NP(DAP)K on nutrient equivalent basis showed variable influence on available N, P and K, due to the combination with SSP and DAP. Irrespective of placement in sand, red soil and hill soil encapsulated pellet having DAP recorded higher available nutrients than the pellet having SSP, invariably in all weeks of measurement. This could be related to the variations in the sources of N and P. Supply of N and P as ammonium phosphate was found to be superior in soil retention when compared urea and SSP.

Manure pellet placement along with encapsulated pellet showed its conspicuous effect on available nutrients. Comparing with presence and absence of manure pellet, there was a

definite decrease in available nutrients when manure pellet was positioned. The benefit of manure pellet was expected to be multipurpose.

With each Nutripellet pack, manure pellet was present occupying about 5 ml of volume. Due to low bulk density, manure pellet would have exhibited more pore space and water holding capacity. Since vermicompost was used to make manure pellet, it would have acted as nutrient reservoir by way of substantial immobilization of N and P compounds which were slowly released from fertilizer pellet. Within the root zone manure pellet thus could have as the whole offered space for microbial activity, nutrient adsorption, immobilization, water storage, buffering centre, etc as the volume of manure pellet remained intact even after eleven weeks of incubation.

More of soluble fertilizer nutrients were possibly retained in manure pellet in the solution, as immobilized compounds by microbes and as surface adsorption on colloidal or soluble forms of carbon compounds resulting in the process of decomposition. At every time of available nutrient estimation fertilizer pellet and manure pellet were removed out of the soil. Only the remaining soil was sampled and estimated for available N, P and K. Hence, available nutrients estimated in soil where manure pellet was present exhibited lower nutrient status than soil without manure pellet, as nutrients held in manure pellet was excluded.

CONCLUSION

Placement of Nutripellet pack caused considerable nutrient enrichment in incubated soil as well as changed physico chemical properties. Soil reaction (pH), electrical conductivity and available forms of N, P and K in soil were estimated up to 11 weeks after incubation (WAI). Among the periods, pH varied from 6.68 to 8.70 in sand, 6.53 to 9.31 in red soil and 5.59 to 9.50 in hill soil. Electrical conductivity (dS m^{-1}) varied from 0.70 to 4.31 in sand, from 0.71 to 5.88 in red soil and from 1.85 to 7.88 in hill soil. Among the soil types, EC was high in hill soil (6.63) followed by red soil (5.55) and sand (4.73).

High available N observed with Nutripellet pack with NP(DAP)K was 201 mg at 5 weeks in sand, 518 mg at 6 weeks in red soil and 964 mg at 8 weeks in hill soil. High available N observed for Nutripellet pack with NP(SSP)K was 109 mg at 7 weeks in sand, 858 mg at 4 weeks in red soil and 896 mg at 4 weeks in hill soil.

Available P observed was high with Nutripellet pack with NP(DAP)K showing 87.9 mg at 7 weeks in sand, 64.0 mg at 9 weeks in red soil and 111 mg at 8 weeks in hill soil.

Comment [Reviewer19]: a)What if the experiment was conducted under field conditions with crop plants are present
b)Plant roots/mycorrhizae are also exudates labile low molecular weight compounds into the soil, will the soil pH and EC behave the same?
c)Impact on intrinsically developed (already existing) soil organic matter, since you are adding NPK, as N amendment could impact the soil C/N ration
d)What about the impact on less duration crops such as vegetables with 30-60 days?
e) What are the real world implications based on your research

Available P observed was high for Nutripellet pack with NP(SSP)K was 21.6 mg at 7 weeks in sand, 43.8 mg at 7 weeks in red soil and 121 mg at 4 weeks in hill soil.

Available K estimated in placement of Nutripellet pack with NP(DAP)K was high indicating 249 mg at 2 weeks in sand, 233 mg at 4 weeks in red soil and 211 mg at 9 weeks in hill soil. Available K estimated in placement of Nutripellet pack with NP(SSP)K was high indicating 264 mg at 2 weeks in sand, 251 mg at 8 weeks in red soil and 245 mg at 10 weeks in hill soil.

REFERENCES:

Arulmozhiselvan, K., R. Vengatesan and M. Deivanai , 2009. Nutriseed Holder technique for increasing nutrient use efficiency and yield under wetland and upland situations in rice and maize.Research on Crops 10(3) : 473-480.

Asha, V. S. and K. Arulmozhiselvan. 2006. 15N Tracer technique for studying efficiency of deep placed fertilizer through Nutriseed holder in direct seeded rice. J. Nuclear Agric. Boil. : 35 (1):1-14

Kalaiselvi, B. and Arulmozhiselvan, 2013.Nutriseed Pack technique for enhancement of maize yield under drip irrigation. Asian J. Soil Sci., 8 (2): 221-225.

Muthukrishnan, R. and Arulmozhiselvan,K. 2013. Response of Nutripellet Pack placement on marigold yield and its components.African J of Agric Res 8(48): 6332-6336.

Radhika K. 2010. Nutriseed pack technique for enhancing yield of maize under surface and drip irrigation. Ph.D. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Vengatesan, R. 2007. Nutriseed Holder Technique for Enhancing yield of Maize under Surface, micro Sprinkler and Drip Irrigation Methods. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Surabhi Hota ans K. Arulmozhiselvan, Effect of nutriseed pack placement on growth, yield and nutrient uptake of tomato (Lycopersiconesculentum) under drip irrigation. Journal of Applied and Natural Science. 8 (4): 2128-2132 (2016).

Table 1. Effect of fertilizer pellet pack and Nutripellet pack on pH of sand, red soil and hill soil at weeks after incubation

WAI>>	1	2	3	4	5	6	7	8	9	10	11	Mean
Treatments	**Sand**											
FPP - NP(DAP)K	8.15	8.38	8.45	9.09	8.76	7.95	7.45	6.98	7.49	8.46	6.96	8.01
FPP - NP(SSP)K	8.16	8.38	8.31	8.77	8.52	7.94	7.63	7.01	7.15	8.5	7.04	7.95
FPP - NP(DAP)K (porous)	8.29	8.45	8.36	9.04	8.55	7.92	7.72	6.86	7.48	8.56	7.34	8.05
FPP - NP(SSP)K (porous)	7.99	8.19	8.26	8.84	8.63	7.82	7.57	7.08	7.18	8.01	6.75	7.85
NPP - NP(DAP)K	7.54	8.23	8.10	8.53	8.48	7.69	7.89	6.39	7.27	8.26	7.01	7.76
NPP - NP(SSP)K	7.71	8.19	7.88	8.25	8.05	7.76	7.82	6.46	7.06	8.14	6.54	7.62
NPP - NP(DAP)K(porous)	8.09	8.31	8.02	8.63	8.51	7.82	7.78	6.41	6.76	8.21	6.96	7.77
NPP - NP(SSP)K(porous)	7.62	7.93	7.87	8.41	8.31	7.69	7.80	6.27	6.66	8.06	6.22	7.53
Mean	7.94	8.25	8.16	8.70	8.48	7.82	7.71	6.68	7.13	8.28	6.84	
	Red soil											
FPP - NP(DAP)K	8.08	8.45	8.68	8.56	8.89	8.24	8.09	7.24	8.06	8.54	6.77	8.15
FPP - NP(SSP)K	7.98	8.61	8.95	9.31	8.59	8.52	7.67	7.33	7.49	8.57	7.07	8.19
FPP - NP(DAP)K (porous)	8.64	8.95	8.58	8.84	9.11	8.31	7.62	7.21	8.09	8.38	7.48	8.29
FPP - NP(SSP)K (porous)	8.02	8.34	8.56	9.08	8.58	8.58	8.01	7.43	7.68	7.88	7.35	8.14
NPP - NP(DAP)K	7.96	8.51	8.51	8.7	8.97	8.55	8.01	6.85	8.01	8.18	7.37	8.15
NPP - NP(SSP)K	8.15	8.21	8.66	8.28	8.65	8.53	7.86	6.53	7.01	7.93	7.07	7.90
NPP - NP(DAP)K(porous)	8.57	8.83	8.46	8.74	8.85	8.42	7.87	6.68	7.91	8.11	7.22	8.15
NPP - NP(SSP)K(porous)	7.91	8.05	8.41	8.04	8.61	8.29	7.98	6.93	6.65	7.97	6.79	7.78
Mean	8.16	8.49	8.60	8.69	8.78	8.43	7.89	7.02	7.61	8.20	7.14	
	Hill Soil											
FPP - NP(DAP)K	7.05	7.98	7.87	7.92	8.97	8.78	8.71	7.06	7.94	8.36	7.56	8.02
FPP - NP(SSP)K	6.81	6.73	7.11	9.43	8.24	8.25	8.73	7.74	7.92	8.12	7.83	7.90
FPP - NP(DAP)K (porous)	8.54	9.06	8.68	8.37	8.94	8.74	8.82	7.64	7.98	8.24	7.54	8.41
FPP - NP(SSP)K (porous)	6.73	8.4	8.49	9.21	8.56	8.8	8.85	7.22	7.71	8.02	7.8	8.16
NPP - NP(DAP)K	6.93	8.27	7.60	7.71	8.26	9.15	9.01	7.65	6.85	8.23	7.99	7.97
NPP - NP(SSP)K	7.64	7.32	7.55	9.11	8.51	8.22	8.64	6.96	6.32	7.81	6.76	7.71
NPP - NP(DAP)K(porous)	7.65	9.04	8.61	8.96	9.18	8.74	8.98	7.76	6.28	8.01	7.82	8.27
NPP - NP(SSP)K(porous)	6.72	8.25	7.64	9.50	8.46	8.54	9.37	6.93	5.59	7.91	7.37	7.84
Mean	7.26	8.12	7.94	8.77	8.64	8.65	8.88	7.37	7.07	8.09	7.58	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.12	0.14	0.39	**Red**	0.13	0.15	0.43	**Hill**	0.14	0.16	0.45
CD (0.05)		0.20	0.23	0.65		0.21	0.25	0.71		0.23	0.27	0.75

Table 2. Effect of fertilizer pellet pack and Nutripellet pack on EC (dSm^{-1}) of sand, red soil and hill soil at weeks after incubation

WAI>>	1	2	3	4	5	6	7	8	9	10	11	Mean
Treatments	**Sand**											
FPP - NP(DAP)K	0.10	0.17	1.47	2.70	3.58	5.79	5.51	4.81	5.89	4.87	3.06	3.45
FPP - NP(SSP)K	0.09	0.13	0.15	1.16	1.03	1.14	0.80	1.01	1.05	0.99	0.99	0.78
FPP - NP(DAP)K (porous)	1.00	3.96	3.88	6.23	5.00	3.62	8.52	4.23	4.97	4.46	3.77	4.51
FPP - NP(SSP)K (porous)	0.24	1.22	0.40	0.82	2.21	2.63	2.84	3.20	2.95	3.67	2.22	2.04
NPP - NP(DAP)K	0.35	1.24	2.23	2.37	5.51	3.20	5.22	4.17	3.39	4.70	3.14	3.23
NPP - NP(SSP)K	0.30	0.44	0.64	1.28	1.31	1.32	2.23	1.44	0.91	1.93	2.46	1.30
NPP - NP(DAP)K(porous)	3.00	4.17	4.21	4.70	7.00	5.04	6.38	5.41	3.09	4.73	4.28	4.73
NPP - NP(SSP)K(porous)	0.50	2.34	1.73	1.27	2.60	3.19	2.99	3.41	2.76	3.52	3.31	2.51
Mean	0.70	1.71	1.84	2.57	3.53	3.24	4.31	3.46	3.13	3.61	2.90	
	Red soil											
FPP - NP(DAP)K	0.08	0.99	1.35	3.55	5.26	6.72	7.11	5.24	6.36	2.98	3.50	3.92
FPP - NP(SSP)K	0.14	0.12	0.43	0.84	0.82	0.83	0.85	1.56	2.34	3.17	3.85	1.36
FPP - NP(DAP)K (porous)	1.79	2.39	5.03	4.46	5.22	6.30	4.93	5.29	6.83	5.83	6.12	4.93
FPP - NP(SSP)K (porous)	0.29	1.20	2.82	3.56	5.45	4.08	7.98	6.66	5.96	5.64	4.53	4.38
NPP - NP(DAP)K	0.25	1.32	4.96	5.83	6.48	5.81	6.71	5.74	5.31	6.33	5.22	4.91
NPP - NP(SSP)K	0.12	0.41	0.41	1.42	2.47	3.14	3.51	4.12	4.22	4.28	4.02	2.56
NPP - NP(DAP)K(porous)	2.60	1.61	5.35	4.34	7.85	7.68	7.79	6.68	5.26	4.99	6.88	5.55
NPP - NP(SSP)K(porous)	0.40	1.37	3.75	4.02	4.63	6.68	8.19	7.74	7.06	8.13	6.09	5.28
Mean	0.71	1.18	3.01	3.50	4.77	5.16	5.88	5.38	5.42	5.17	5.03	
	Hill Soil											
FPP - NP(DAP)K	1.50	2.09	2.45	3.16	5.80	6.45	12.08	4.61	6.63	7.85	3.97	5.14
FPP - NP(SSP)K	1.27	0.58	0.19	0.43	0.59	1.05	1.14	1.31	1.92	2.14	2.41	1.18
FPP - NP(DAP)K (porous)	3.14	4.77	4.70	4.82	4.22	8.18	9.73	10.05	7.52	6.86	4.26	6.20
FPP - NP(SSP)K (porous)	1.20	1.93	2.41	4.85	4.01	4.40	5.95	6.46	6.75	3.77	3.88	4.15
NPP - NP(DAP)K	1.52	3.53	4.27	3.82	4.19	5.71	10.17	8.61	6.59	7.55	5.69	5.60
NPP - NP(SSP)K	2.80	0.92	0.82	0.85	1.02	1.36	2.06	2.65	3.05	2.89	2.18	1.87
NPP - NP(DAP)K(porous)	1.69	5.67	6.44	5.35	6.41	6.04	10.85	8.64	6.23	10.31	5.28	6.63
NPP - NP(SSP)K(porous)	1.66	1.94	2.11	6.05	4.35	3.97	11.03	9.21	7.85	7.50	5.18	5.53
Mean	1.85	2.68	2.92	3.67	3.82	4.65	7.88	6.44	5.82	6.11	4.11	
	Sand	T	P	T x P	**Red**	T	P	T x P	**Hill**	T	P	T x P
SEd		0.08	0.09	0.26		0.07	0.09	0.25		0.11	0.13	0.35

CD (0.05)		0.13	0.15	0.43		0.12	0.14	0.41		0.18	0.21	0.59

Table 3. Effect of fertilizer pellet pack and Nutripellet pack on available N (mg) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	2.10	24.5	56.7	44.8	149.8	79.8	119.0	133.0	387.8	117.6	130.2	113.2
FPP - NP(SSP)K	3.36	31.5	31.5	51.8	91.0	46.2	78.4	35.0	56.0	37.8	84.7	49.8
FPP - NP(DAP)K (porous)	22.1	92.4	78.4	65.8	197.4	65.1	124.6	164.5	302.4	79.8	130.9	120.3
FPP - NP(SSP)K (porous)	4.06	53.2	24.5	67.2	54.6	43.4	107.1	104.3	95.2	74.9	69.3	63.4
NPP - NP(DAP)K	4.34	49.7	49.0	56.0	200.9	61.6	130.9	165.9	120.4	98.7	151.2	99.0
NPP - NP(SSP)K	6.16	48.3	23.8	57.4	71.4	32.2	109.2	53.2	53.2	56.7	86.8	54.4
NPP - NP(DAP)K(porous)	33.7	41.3	84.7	82.6	134.4	94.5	156.1	203.0	146.3	62.3	150.5	114.5
NPP - NP(SSP)K(porous)	47.0	72.1	51.1	39.2	178.5	65.1	92.4	107.1	476.0	71.4	123.2	120.3
Mean	15.4	60.4	50.0	58.1	134.8	61.0	114.7	120.8	204.7	74.9	115.9	
	Red soil											
FPP - NP(DAP)K	82.32	198.1	187.6	449.4	480.9	454.3	484.4	550.2	543.9	492.8	212.1	376.0
FPP - NP(SSP)K	55.44	105.0	122.5	744.8	248.5	340.2	243.6	172.9	268.8	347.9	334.6	271.3
FPP - NP(DAP)K (porous)	79.38	358.4	471.1	823.2	363.3	418.6	452.2	481.6	438.9	516.6	458.5	442.0
FPP - NP(SSP)K (porous)	83.30	202.3	331.8	646.8	420.0	395.5	483.7	435.4	431.9	472.5	359.8	387.6
NPP - NP(DAP)K	47.18	219.1	395.5	448.0	511.7	518.0	512.4	447.3	463.4	491.4	427.0	407.4
NPP - NP(SSP)K	56.70	113.4	198.8	858.2	319.9	380.1	230.3	301.7	336.7	422.8	331.8	322.8
NPP - NP(DAP)K(porous)	172.9	290.5	503.3	749.0	487.2	476.0	536.2	531.3	527.1	598.5	508.2	489.1
NPP - NP(SSP)K(porous)	55.30	175.0	389.2	697.2	438.2	546.7	507.5	513.1	493.5	408.8	225.4	404.5
Mean	79.07	207.7	325.0	677.1	408.7	441.2	431.3	429.2	438.0	468.9	357.2	
	Hill Soil											
FPP - NP(DAP)K	180.6	291.2	343.0	674.8	566.3	548.1	856.1	529.2	847.7	687.4	630.0	559.5
FPP - NP(SSP)K	168.7	218.4	215.6	1078.0	539.0	401.1	497.0	631.4	509.6	506.8	443.8	473.6
FPP - NP(DAP)K (porous)	350.0	385.7	523.6	726.6	606.9	557.2	755.3	903.7	969.5	861.7	707.0	667.9
FPP - NP(SSP)K (porous)	196.0	300.3	373.8	949.2	436.1	515.9	656.6	652.4	728.0	584.5	553.7	540.6
NPP - NP(DAP)K	200.2	390.6	473.2	666.4	368.9	530.6	938.7	963.9	589.4	806.4	729.4	605.3
NPP - NP(SSP)K	221.2	268.8	270.2	896.0	378.7	351.4	602.0	564.2	461.3	608.3	408.8	457.4
NPP - NP(DAP)K(porous)	490.0	551.6	628.6	974.4	595.7	595.7	804.3	842.8	1027.6	879.9	812.7	745.8
NPP - NP(SSP)K(porous)	182.0	353.5	325.5	1068.2	427.7	465.5	687.4	714.0	880.6	851.2	653.1	600.8

Mean	248.6	345.1	394.2	879.2	489.9	495.7	724.7	725.2	751.7	723.3	617.3	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	4.26	4.99	14.13	**Red**	7.28	8.54	24.14	**Hill**	8.26	9.69	27.40
CD (0.05)		7.08	8.30	23.69		12.11	14.20	40.55		13.74	16.11	45.46

Table 4. Effect of fertilizer pellet pack and Nutripellet pack on available K (mg) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	40.9	147.3	196.5	134.0	172.9	192.4	190.0	255.2	182.4	178.4	234.5	175.0
FPP - NP(SSP)K	39.9	138.3	191.1	220.1	223.8	201.5	222.7	185.8	166.3	205.9	183.8	179.9
FPP - NP(DAP)K (porous)	112.3	581.6	731.6	166.9	226.7	230.4	174.7	195.9	182.9	186.4	184.0	270.3
FPP - NP(SSP)K (porous)	50.3	599.5	391.5	193.7	226.5	195.7	218.7	164.5	160.5	195.5	184.7	234.7
NPP - NP(DAP)K	53.4	249.0	231.5	214.9	199.8	238.8	205.0	246.8	208.3	194.5	142.9	198.6
NPP - NP(SSP)K	52.1	226.9	263.9	231.1	225.3	189.6	143.0	172.3	244.6	206.8	190.7	195.1
NPP - NP(DAP)K(porous)	234.7	525.9	667.9	148.5	240.0	197.5	154.9	199.5	211.5	223.1	196.6	272.7
NPP - NP(SSP)K(porous)	106.6	596.6	698.9	161.6	136.2	212.0	211.2	167.6	139.2	225.9	202.7	259.8
Mean	86.3	383.1	421.6	183.9	206.4	207.2	190.0	198.4	187.0	202.1	190.0	
	Red soil											
FPP - NP(DAP)K	123.1	185.6	246.7	239.0	178.4	169.3	142.6	174.5	178.3	191.0	155.8	180.4
FPP - NP(SSP)K	74.7	228.8	245.5	236.6	187.0	243.2	181.4	183.2	210.9	174.3	182.6	195.3
FPP - NP(DAP)K (porous)	164.8	631.4	678.9	230.9	133.1	150.6	188.2	171.7	166.1	200.8	172.5	262.6
FPP - NP(SSP)K (porous)	101.1	625.4	717.2	171.3	193.7	185.6	169.0	134.6	137.3	193.8	170.8	254.5
NPP - NP(DAP)K	78.8	108.5	209.1	232.8	196.1	256.1	199.5	248.9	162.1	191.5	138.0	183.8
NPP - NP(SSP)K	99.5	138.0	174.5	240.1	222.1	118.3	201.5	250.8	244.6	188.6	176.4	186.8
NPP - NP(DAP)K(porous)	172.5	613.8	636.0	202.0	161.4	194.1	176.7	139.6	188.2	166.3	208.2	259.9
NPP - NP(SSP)K(porous)	90.6	640.7	660.8	205.4	170.9	185.8	147.4	192.9	151.9	218.7	236.2	263.7
Mean	113.1	396.5	446.1	219.8	180.3	187.9	175.8	187.0	179.9	190.6	180.1	
	Hill Soil											
FPP - NP(DAP)K	217.9	214.5	249.5	257.2	179.4	159.6	175.7	150.3	162.2	249.1	158.5	197.6
FPP - NP(SSP)K	236.1	183.7	245.6	243.0	180.7	196.7	137.8	257.5	181.5	179.6	200.9	203.9
FPP - NP(DAP)K (porous)	399.7	772.7	429.4	188.6	186.1	161.8	201.1	208.4	144.7	191.5	233.0	283.4
FPP - NP(SSP)K (porous)	231.0	685.6	722.6	211.1	199.6	155.4	180.0	199.6	165.5	169.5	156.2	279.6
NPP - NP(DAP)K	165.8	163.2	174.6	181.6	207.4	145.7	165.9	187.6	210.9	199.5	178.6	180.1
NPP - NP(SSP)K	235.8	110.6	119.1	175.2	178.1	142.3	133.9	138.0	220.7	245.1	214.5	173.9

NPP - NP(DAP)K(porous)	166.7	739.9	663.9	196.5	138.3	207.4	211.0	166.8	169.1	200.9	216.7	279.8
NPP - NP(SSP)K(porous)	367.7	209.8	610.0	179.8	216.9	202.8	184.3	182.4	171.2	217.9	130.0	243.0
Mean	252.6	385.0	401.8	204.1	185.8	171.5	173.7	186.3	178.2	206.6	186.1	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	6.2	7.3	20.7	**Red**	5.8	6.8	19.3	**Hill**	6.0	7.0	19.9
CD (0.05)		10.4	12.2	34.6		9.7	11.3	32.2		10.0	11.7	33.1

Fig. 1. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in sand

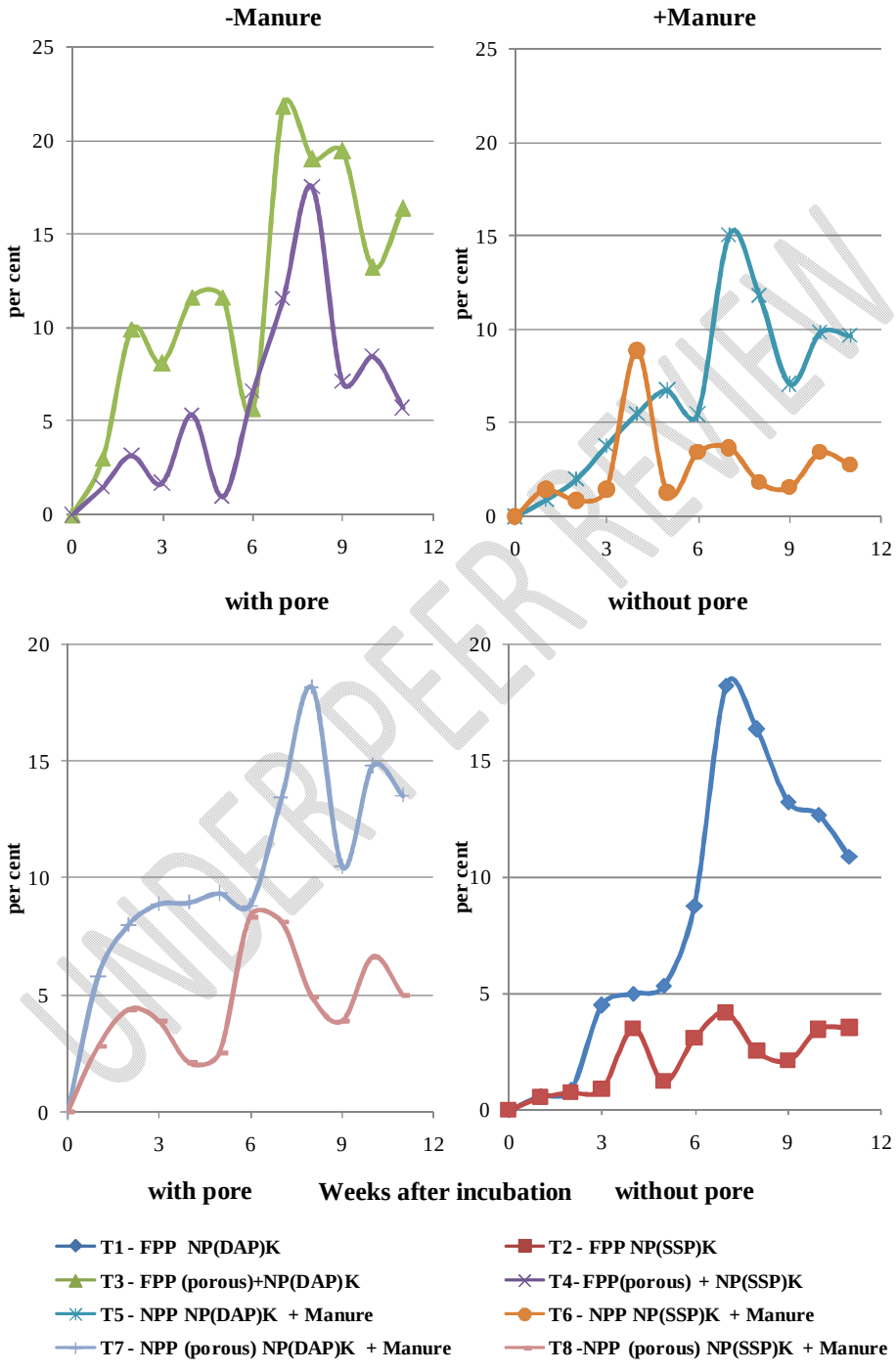


Fig. 2. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in red soil

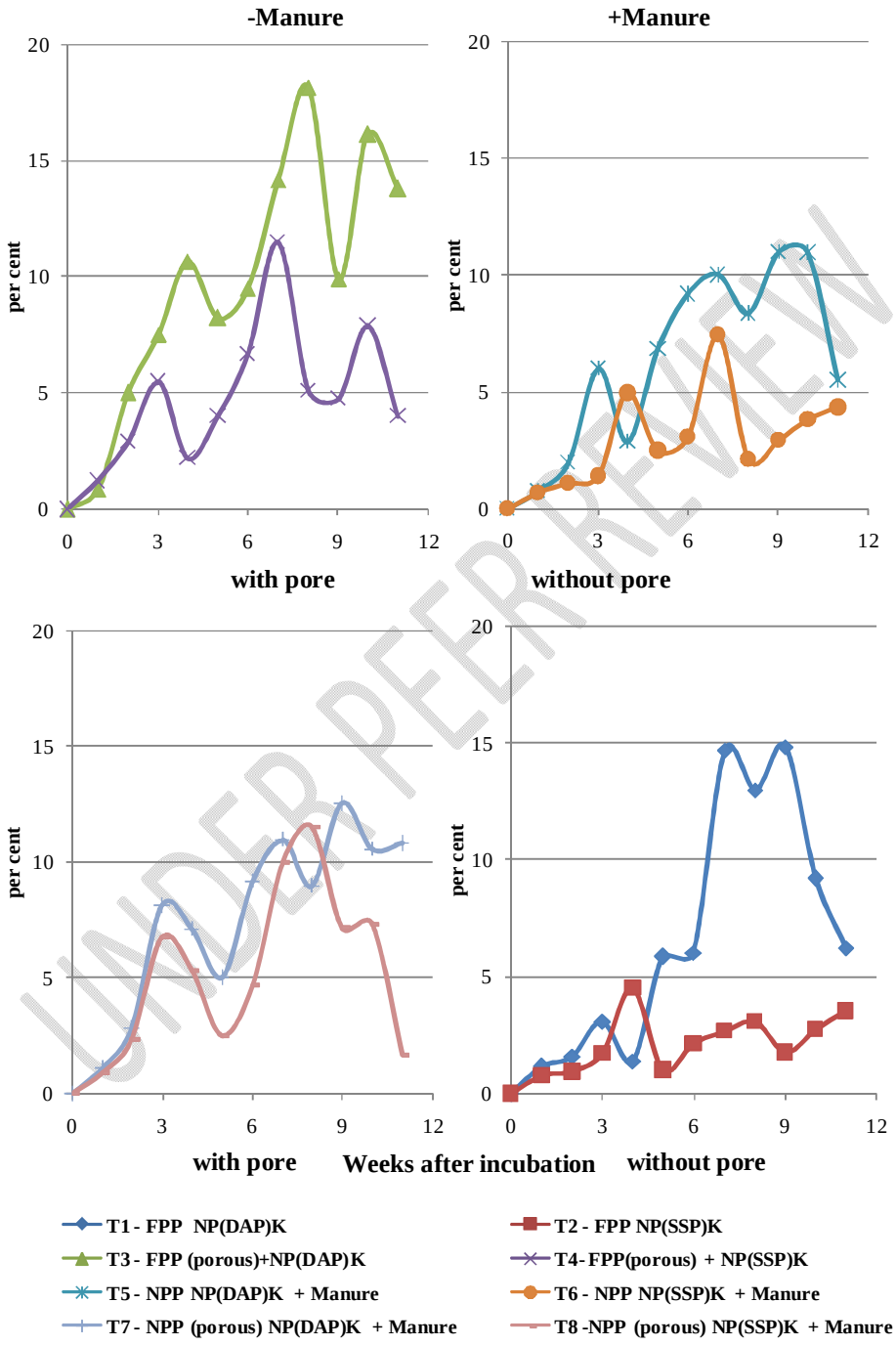
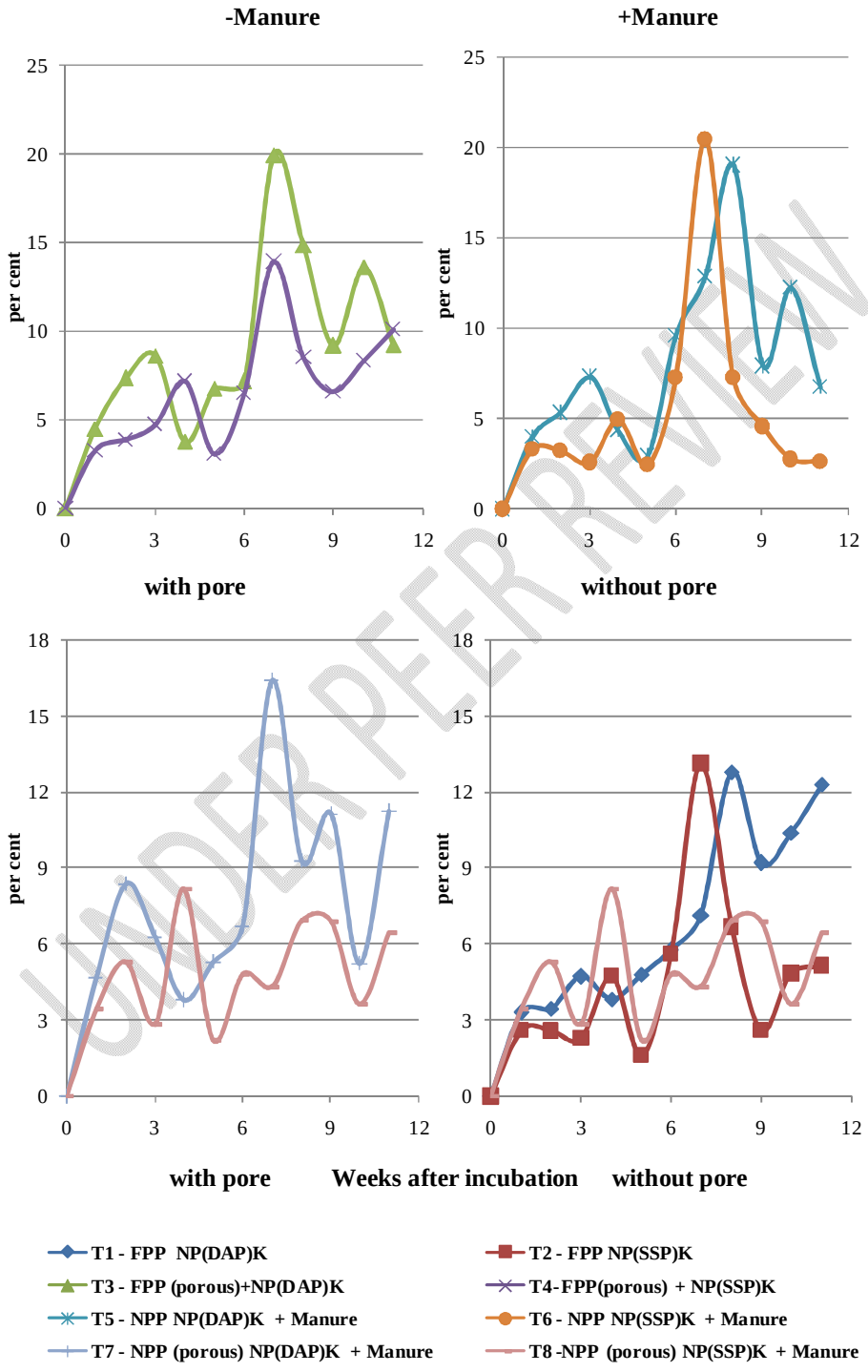


Fig. 3. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in hilly soil



Conclusion

Placement of Nutripellet pack caused considerable nutrient enrichment in incubated soil as well as changed physico chemical properties. Soil reaction (pH), electrical conductivity and available forms of N, P and K in soil were estimated up to 11 weeks after incubation (WAI). Among the periods, pH varied from 6.68 to 8.70 in sand, 6.53 to 9.31 in red soil and 5.59 to 9.50 in hill soil. Electrical conductivity (dS m^{-1}) varied from 0.70 to 4.31 in sand, from 0.71 to 5.88 in red soil and from 1.85 to 7.88 in hill soil. Among the soil types, EC was high in hill soil (6.63) followed by red soil (5.55) and sand (4.73).

High available N observed with Nutripellet pack with NP(DAP)K was 201 mg at 5 weeks in sand, 518 mg at 6 weeks in red soil and 964 mg at 8 weeks in hill soil. High available N observed for Nutripellet pack with NP(SSP)K was 109 mg at 7 weeks in sand, 858 mg at 4 weeks in red soil and 896 mg at 4 weeks in hill soil.

Available P observed was high with Nutripellet pack with NP(DAP)K showing 87.9 mg at 7 weeks in sand, 64.0 mg at 9 weeks in red soil and 111 mg at 8 weeks in hill soil. Available P observed was high for Nutripellet pack with NP(SSP)K was 21.6 mg at 7 weeks in sand, 43.8 mg at 7 weeks in red soil and 121 mg at 4 weeks in hill soil.

Available K estimated in placement of Nutripellet pack with NP(DAP)K was high indicating 249 mg at 2 weeks in sand, 233 mg at 4 weeks in red soil and 211 mg at 9 weeks in hill soil. Available K estimated in placement of Nutripellet pack with NP(SSP)K was high indicating 264 mg at 2 weeks in sand, 251 mg at 8 weeks in red soil and 245 mg at 10 weeks in hill soil.

Comment [Reviewer21]: I think this is a repetition?

Table 5. Effect of fertilizer pellet pack and Nutripellet pack on pH of sand, red soil and hill soil at weeks after incubation

WAI>>	1	2	3	4	5	6	7	8	9	10	11	Mean
Treatments	**Sand**											
FPP - NP(DAP)K	8.15	8.38	8.45	9.09	8.76	7.95	7.45	6.98	7.49	8.46	6.96	8.01
FPP - NP(SSP)K	8.16	8.38	8.31	8.77	8.52	7.94	7.63	7.01	7.15	8.5	7.04	7.95
FPP - NP(DAP)K (porous)	8.29	8.45	8.36	9.04	8.55	7.92	7.72	6.86	7.48	8.56	7.34	8.05
FPP - NP(SSP)K (porous)	7.99	8.19	8.26	8.84	8.63	7.82	7.57	7.08	7.18	8.01	6.75	7.85
NPP - NP(DAP)K	7.54	8.23	8.10	8.53	8.48	7.69	7.89	6.39	7.27	8.26	7.01	7.76
NPP - NP(SSP)K	7.71	8.19	7.88	8.25	8.05	7.76	7.82	6.46	7.06	8.14	6.54	7.62
NPP - NP(DAP)K(porous)	8.09	8.31	8.02	8.63	8.51	7.82	7.78	6.41	6.76	8.21	6.96	7.77
NPP - NP(SSP)K(porous)	7.62	7.93	7.87	8.41	8.31	7.69	7.80	6.27	6.66	8.06	6.22	7.53
Mean	7.94	8.25	8.16	8.70	8.48	7.82	7.71	6.68	7.13	8.28	6.84	
	Red soil											
FPP - NP(DAP)K	8.08	8.45	8.68	8.56	8.89	8.24	8.09	7.24	8.06	8.54	6.77	8.15
FPP - NP(SSP)K	7.98	8.61	8.95	9.31	8.59	8.52	7.67	7.33	7.49	8.57	7.07	8.19
FPP - NP(DAP)K (porous)	8.64	8.95	8.58	8.84	9.11	8.31	7.62	7.21	8.09	8.38	7.48	8.29
FPP - NP(SSP)K (porous)	8.02	8.34	8.56	9.08	8.58	8.58	8.01	7.43	7.68	7.88	7.35	8.14
NPP - NP(DAP)K	7.96	8.51	8.51	8.7	8.97	8.55	8.01	6.85	8.01	8.18	7.37	8.15
NPP - NP(SSP)K	8.15	8.21	8.66	8.28	8.65	8.53	7.86	6.53	7.01	7.93	7.07	7.90
NPP - NP(DAP)K(porous)	8.57	8.83	8.46	8.74	8.85	8.42	7.87	6.68	7.91	8.11	7.22	8.15
NPP - NP(SSP)K(porous)	7.91	8.05	8.41	8.04	8.61	8.29	7.98	6.93	6.65	7.97	6.79	7.78
Mean	8.16	8.49	8.60	8.69	8.78	8.43	7.89	7.02	7.61	8.20	7.14	
	Hill Soil											
FPP - NP(DAP)K	7.05	7.98	7.87	7.92	8.97	8.78	8.71	7.06	7.94	8.36	7.56	8.02
FPP - NP(SSP)K	6.81	6.73	7.11	9.43	8.24	8.25	8.73	7.74	7.92	8.12	7.83	7.90
FPP - NP(DAP)K (porous)	8.54	9.06	8.68	8.37	8.94	8.74	8.82	7.64	7.98	8.24	7.54	8.41
FPP - NP(SSP)K (porous)	6.73	8.4	8.49	9.21	8.56	8.8	8.85	7.22	7.71	8.02	7.8	8.16
NPP - NP(DAP)K	6.93	8.27	7.60	7.71	8.26	9.15	9.01	7.65	6.85	8.23	7.99	7.97
NPP - NP(SSP)K	7.64	7.32	7.55	9.11	8.51	8.22	8.64	6.96	6.32	7.81	6.76	7.71

NPP - NP(DAP)K(porous)	7.65	9.04	8.61	8.96	9.18	8.74	8.98	7.76	6.28	8.01	7.82	8.27
NPP - NP(SSP)K(porous)	6.72	8.25	7.64	9.50	8.46	8.54	9.37	6.93	5.59	7.91	7.37	7.84
Mean	7.26	8.12	7.94	8.77	8.64	8.65	8.88	7.37	7.07	8.09	7.58	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.12	0.14	0.39	**Red**	0.13	0.15	0.43	**Hill**	0.14	0.16	0.45
CD (0.05)		0.20	0.23	0.65		0.21	0.25	0.71		0.23	0.27	0.75

Table 6. Effect of fertilizer pellet pack and Nutripellet pack on EC (dSm^{-1}) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	0.10	0.17	1.47	2.70	3.58	5.79	5.51	4.81	5.89	4.87	3.06	3.45
FPP - NP(SSP)K	0.09	0.13	0.15	1.16	1.03	1.14	0.80	1.01	1.05	0.99	0.99	0.78
FPP - NP(DAP)K (porous)	1.00	3.96	3.88	6.23	5.00	3.62	8.52	4.23	4.97	4.46	3.77	4.51
FPP - NP(SSP)K (porous)	0.24	1.22	0.40	0.82	2.21	2.63	2.84	3.20	2.95	3.67	2.22	2.04
NPP - NP(DAP)K	0.35	1.24	2.23	2.37	5.51	3.20	5.22	4.17	3.39	4.70	3.14	3.23
NPP - NP(SSP)K	0.30	0.44	0.64	1.28	1.31	1.32	2.23	1.44	0.91	1.93	2.46	1.30
NPP - NP(DAP)K(porous)	3.00	4.17	4.21	4.70	7.00	5.04	6.38	5.41	3.09	4.73	4.28	4.73
NPP - NP(SSP)K(porous)	0.50	2.34	1.73	1.27	2.60	3.19	2.99	3.41	2.76	3.52	3.31	2.51
Mean	0.70	1.71	1.84	2.57	3.53	3.24	4.31	3.46	3.13	3.61	2.90	
	Red soil											
FPP - NP(DAP)K	0.08	0.99	1.35	3.55	5.26	6.72	7.11	5.24	6.36	2.98	3.50	3.92
FPP - NP(SSP)K	0.14	0.12	0.43	0.84	0.82	0.83	0.85	1.56	2.34	3.17	3.85	1.36
FPP - NP(DAP)K (porous)	1.79	2.39	5.03	4.46	5.22	6.30	4.93	5.29	6.83	5.83	6.12	4.93
FPP - NP(SSP)K (porous)	0.29	1.20	2.82	3.56	5.45	4.08	7.98	6.66	5.96	5.64	4.53	4.38
NPP - NP(DAP)K	0.25	1.32	4.96	5.83	6.48	5.81	6.71	5.74	5.31	6.33	5.22	4.91
NPP - NP(SSP)K	0.12	0.41	0.41	1.42	2.47	3.14	3.51	4.12	4.22	4.28	4.02	2.56
NPP - NP(DAP)K(porous)	2.60	1.61	5.35	4.34	7.85	7.68	7.79	6.68	5.26	4.99	6.88	5.55
NPP - NP(SSP)K(porous)	0.40	1.37	3.75	4.02	4.63	6.68	8.19	7.74	7.06	8.13	6.09	5.28
Mean	0.71	1.18	3.01	3.50	4.77	5.16	5.88	5.38	5.42	5.17	5.03	
	Hill Soil											
FPP - NP(DAP)K	1.50	2.09	2.45	3.16	5.80	6.45	12.08	4.61	6.63	7.85	3.97	5.14
FPP - NP(SSP)K	1.27	0.58	0.19	0.43	0.59	1.05	1.14	1.31	1.92	2.14	2.41	1.18
FPP - NP(DAP)K (porous)	3.14	4.77	4.70	4.82	4.22	8.18	9.73	10.05	7.52	6.86	4.26	6.20

FPP - NP(SSP)K (porous)	1.20	1.93	2.41	4.85	4.01	4.40	5.95	6.46	6.75	3.77	3.88	4.15
NPP - NP(DAP)K	1.52	3.53	4.27	3.82	4.19	5.71	10.17	8.61	6.59	7.55	5.69	5.60
NPP - NP(SSP)K	2.80	0.92	0.82	0.85	1.02	1.36	2.06	2.65	3.05	2.89	2.18	1.87
NPP - NP(DAP)K(porous)	1.69	5.67	6.44	5.35	6.41	6.04	10.85	8.64	6.23	10.31	5.28	6.63
NPP - NP(SSP)K(porous)	1.66	1.94	2.11	6.05	4.35	3.97	11.03	9.21	7.85	7.50	5.18	5.53
Mean	1.85	2.68	2.92	3.67	3.82	4.65	7.88	6.44	5.82	6.11	4.11	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.08	0.09	0.26	**Red**	0.07	0.09	0.25	**Hill**	0.11	0.13	0.35
CD (0.05)		0.13	0.15	0.43		0.12	0.14	0.41		0.18	0.21	0.59

Table 7. Effect of fertilizer pellet pack and Nutripellet pack on available N (mg) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	2.10	24.5	56.7	44.8	149.8	79.8	119.0	133.0	387.8	117.6	130.2	113.2
FPP - NP(SSP)K	3.36	31.5	31.5	51.8	91.0	46.2	78.4	35.0	56.0	37.8	84.7	49.8
FPP - NP(DAP)K (porous)	22.1	92.4	78.4	65.8	197.4	65.1	124.6	164.5	302.4	79.8	130.9	120.3
FPP - NP(SSP)K (porous)	4.06	53.2	24.5	67.2	54.6	43.4	107.1	104.3	95.2	74.9	69.3	63.4
NPP - NP(DAP)K	4.34	49.7	49.0	56.0	200.9	61.6	130.9	165.9	120.4	98.7	151.2	99.0
NPP - NP(SSP)K	6.16	48.3	23.8	57.4	71.4	32.2	109.2	53.2	53.2	56.7	86.8	54.4
NPP - NP(DAP)K(porous)	33.7	41.3	84.7	82.6	134.4	94.5	156.1	203.0	146.3	62.3	150.5	114.5
NPP - NP(SSP)K(porous)	47.0	72.1	51.1	39.2	178.5	65.1	92.4	107.1	476.0	71.4	123.2	120.3
Mean	15.4	60.4	50.0	58.1	134.8	61.0	114.7	120.8	204.7	74.9	115.9	
	Red soil											
FPP - NP(DAP)K	82.32	198.1	187.6	449.4	480.9	454.3	484.4	550.2	543.9	492.8	212.1	376.0
FPP - NP(SSP)K	55.44	105.0	122.5	744.8	248.5	340.2	243.6	172.9	268.8	347.9	334.6	271.3
FPP - NP(DAP)K (porous)	79.38	358.4	471.1	823.2	363.3	418.6	452.2	481.6	438.9	516.6	458.5	442.0
FPP - NP(SSP)K (porous)	83.30	202.3	331.8	646.8	420.0	395.5	483.7	435.4	431.9	472.5	359.8	387.6
NPP - NP(DAP)K	47.18	219.1	395.5	448.0	511.7	518.0	512.4	447.3	463.4	491.4	427.0	407.4
NPP - NP(SSP)K	56.70	113.4	198.8	858.2	319.9	380.1	230.3	301.7	336.7	422.8	331.8	322.8
NPP - NP(DAP)K(porous)	172.9	290.5	503.3	749.0	487.2	476.0	536.2	531.3	527.1	598.5	508.2	489.1
NPP - NP(SSP)K(porous)	55.30	175.0	389.2	697.2	438.2	546.7	507.5	513.1	493.5	408.8	225.4	404.5
Mean	79.07	207.7	325.0	677.1	408.7	441.2	431.3	429.2	438.0	468.9	357.2	

	Hill Soil											
FPP - NP(DAP)K	180.6	291.2	343.0	674.8	566.3	548.1	856.1	529.2	847.7	687.4	630.0	559.5
FPP - NP(SSP)K	168.7	218.4	215.6	1078.0	539.0	401.1	497.0	631.4	509.6	506.8	443.8	473.6
FPP - NP(DAP)K (porous)	350.0	385.7	523.6	726.6	606.9	557.2	755.3	903.7	969.5	861.7	707.0	667.9
FPP - NP(SSP)K (porous)	196.0	300.3	373.8	949.2	436.1	515.9	656.6	652.4	728.0	584.5	553.7	540.6
NPP - NP(DAP)K	200.2	390.6	473.2	666.4	368.9	530.6	938.7	963.9	589.4	806.4	729.4	605.3
NPP - NP(SSP)K	221.2	268.8	270.2	896.0	378.7	351.4	602.0	564.2	461.3	608.3	408.8	457.4
NPP - NP(DAP)K(porous)	490.0	551.6	628.6	974.4	595.7	595.7	804.3	842.8	1027.6	879.9	812.7	745.8
NPP - NP(SSP)K(porous)	182.0	353.5	325.5	1068.2	427.7	465.5	687.4	714.0	880.6	851.2	653.1	600.8
Mean	248.6	345.1	394.2	879.2	489.9	495.7	724.7	725.2	751.7	723.3	617.3	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	4.26	4.99	14.13	**Red**	7.28	8.54	24.14	**Hill**	8.26	9.69	27.40
CD (0.05)		7.08	8.30	23.69		12.11	14.20	40.55		13.74	16.11	45.46

Table 8. Effect of fertilizer pellet pack and Nutripellet pack on available P (mg) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	3.53	5.22	26.1	29.2	31.2	51.2	106.3	95.4	77.2	74.0	63.5	51.16
FPP - NP(SSP)K	3.11	4.23	5.23	20.43	7.30	18.0	24.7	14.8	12.4	20.4	20.7	13.75
FPP - NP(DAP)K (porous)	17.5	57.7	47.2	68.0	67.7	33.0	127.2	110.9	113.3	77.0	95.4	74.09
FPP - NP(SSP)K (porous)	8.90	18.7	10.0	31.6	5.90	38.9	68.1	103.4	41.9	50.0	33.7	37.34
NPP - NP(DAP)K	5.14	11.5	22.0	32.0	39.2	31.8	87.9	68.7	41.2	57.4	56.4	41.19
NPP - NP(SSP)K	8.43	5.04	8.47	52.21	7.50	20.17	21.6	10.7	9.22	20.2	16.2	16.35
NPP - NP(DAP)K(porous)	33.8	46.7	51.8	52.2	54.5	51.5	78.3	106.1	61.2	86.3	78.8	63.74
NPP - NP(SSP)K(porous)	16.6	26.0	23.1	12.4	15.1	49.3	47.9	29.2	23.2	39.3	29.6	28.33
Mean	12.13	21.88	24.25	37.23	28.53	36.72	70.25	67.37	47.46	53.07	49.30	
	Red soil											
FPP - NP(DAP)K	6.8	9.2	18.2	8.1	34.2	35.1	85.7	75.7	86.5	53.7	36.5	40.9
FPP - NP(SSP)K	4.6	5.5	10.1	26.7	6.0	12.5	15.8	18.2	10.5	16.3	21.0	13.4
FPP - NP(DAP)K (porous)	5.1	29.1	43.8	62.1	48.0	55.3	82.7	105.9	57.8	94.0	80.4	60.4
FPP - NP(SSP)K (porous)	7.2	17.3	32.4	13.1	23.6	39.5	67.8	30.2	28.1	46.5	23.7	29.9
NPP - NP(DAP)K	4.5	11.6	35.0	16.6	39.9	53.6	58.4	48.9	64.0	64.0	32.0	38.9
NPP - NP(SSP)K	4.1	6.4	8.2	29.3	14.8	18.2	43.8	12.5	17.3	22.5	25.7	18.4

NPP - NP(DAP)K(porous)	6.6	16.5	47.3	41.5	29.2	53.5	63.9	52.4	73.0	61.6	63.0	46.2
NPP - NP(SSP)K(porous)	5.5	13.7	39.8	31.4	14.7	27.8	58.9	68.1	42.2	43.3	10.0	32.3
Mean	5.6	13.7	29.4	28.6	26.3	36.9	59.6	51.5	47.4	50.2	36.5	
	Hill Soil											
FPP - NP(DAP)K	19.3	20.3	27.5	22.3	28.0	33.6	41.7	74.5	53.7	60.7	71.9	41.2
FPP - NP(SSP)K	15.5	15.2	13.5	28.1	9.7	33.1	77.5	39.4	15.4	28.6	30.4	27.8
FPP - NP(DAP)K (porous)	26.2	42.8	50.3	21.9	39.4	41.8	116.2	86.6	53.5	79.4	53.6	55.6
FPP - NP(SSP)K (porous)	19.2	22.9	27.9	42.3	18.0	38.5	82.2	50.3	38.9	49.3	59.7	40.8
NPP - NP(DAP)K	23.1	31.0	42.6	25.3	17.0	56.0	74.8	110.9	46.2	71.3	39.3	48.9
NPP - NP(SSP)K	19.4	18.9	15.2	29.1	14.3	42.8	120.5	43.0	26.9	16.2	15.6	32.9
NPP - NP(DAP)K(porous)	27.1	48.8	36.6	22.1	30.9	39.0	95.6	54.1	65.0	30.7	65.5	46.9
NPP - NP(SSP)K(porous)	20.4	31.2	16.9	48.3	13.2	28.5	25.6	40.9	40.8	21.6	38.0	29.6
Mean	21.3	28.9	28.8	29.9	21.3	39.1	79.3	62.5	42.6	44.7	46.7	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	1.12	1.31	3.70	**Red**	0.91	1.07	3.01	**Hill**	0.99	1.16	3.28
CD (0.05)		1.86	2.18	6.20		1.51	1.77	5.08		1.64	1.93	5.54

Table 9. Effect of fertilizer pellet pack and Nutripellet pack on available K (mg) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	40.9	147.3	196.5	134.0	172.9	192.4	190.0	255.2	182.4	178.4	234.5	175.0
FPP - NP(SSP)K	39.9	138.3	191.1	220.1	223.8	201.5	222.7	185.8	166.3	205.9	183.8	179.9
FPP - NP(DAP)K (porous)	112.3	581.6	731.6	166.9	226.7	230.4	174.7	195.9	182.9	186.4	184.0	270.3
FPP - NP(SSP)K (porous)	50.3	599.5	391.5	193.7	226.5	195.7	218.7	164.5	160.5	195.5	184.7	234.7
NPP - NP(DAP)K	53.4	249.0	231.5	214.9	199.8	238.8	205.0	246.8	208.3	194.5	142.9	198.6
NPP - NP(SSP)K	52.1	226.9	263.9	231.1	225.3	189.6	143.0	172.3	244.6	206.8	190.7	195.1
NPP - NP(DAP)K(porous)	234.7	525.9	667.9	148.5	240.0	197.5	154.9	199.5	211.5	223.1	196.6	272.7
NPP - NP(SSP)K(porous)	106.6	596.6	698.9	161.6	136.2	212.0	211.2	167.6	139.2	225.9	202.7	259.8
Mean	86.3	383.1	421.6	183.9	206.4	207.2	190.0	198.4	187.0	202.1	190.0	
	Red soil											
FPP - NP(DAP)K	123.1	185.6	246.7	239.0	178.4	169.3	142.6	174.5	178.3	191.0	155.8	180.4
FPP - NP(SSP)K	74.7	228.8	245.5	236.6	187.0	243.2	181.4	183.2	210.9	174.3	182.6	195.3
FPP - NP(DAP)K (porous)	164.8	631.4	678.9	230.9	133.1	150.6	188.2	171.7	166.1	200.8	172.5	262.6

FPP - NP(SSP)K (porous)	101.1	625.4	717.2	171.3	193.7	185.6	169.0	134.6	137.3	193.8	170.8	254.5
NPP - NP(DAP)K	78.8	108.5	209.1	232.8	196.1	256.1	199.5	248.9	162.1	191.5	138.0	183.8
NPP - NP(SSP)K	99.5	138.0	174.5	240.1	222.1	118.3	201.5	250.8	244.6	188.6	176.4	186.8
NPP - NP(DAP)K(porous)	172.5	613.8	636.0	202.0	161.4	194.1	176.7	139.6	188.2	166.3	208.2	259.9
NPP - NP(SSP)K(porous)	90.6	640.7	660.8	205.4	170.9	185.8	147.4	192.9	151.9	218.7	236.2	263.7
Mean	113.1	396.5	446.1	219.8	180.3	187.9	175.8	187.0	179.9	190.6	180.1	
	Hill Soil											
FPP - NP(DAP)K	217.9	214.5	249.5	257.2	179.4	159.6	175.7	150.3	162.2	249.1	158.5	197.6
FPP - NP(SSP)K	236.1	183.7	245.6	243.0	180.7	196.7	137.8	257.5	181.5	179.6	200.9	203.9
FPP - NP(DAP)K (porous)	399.7	772.7	429.4	188.6	186.1	161.8	201.1	208.4	144.7	191.5	233.0	283.4
FPP - NP(SSP)K (porous)	231.0	685.6	722.6	211.1	199.6	155.4	180.0	199.6	165.5	169.5	156.2	279.6
NPP - NP(DAP)K	165.8	163.2	174.6	181.6	207.4	145.7	165.9	187.6	210.9	199.5	178.6	180.1
NPP - NP(SSP)K	235.8	110.6	119.1	175.2	178.1	142.3	133.9	138.0	220.7	245.1	214.5	173.9
NPP - NP(DAP)K(porous)	166.7	739.9	663.9	196.5	138.3	207.4	211.0	166.8	169.1	200.9	216.7	279.8
NPP - NP(SSP)K(porous)	367.7	209.8	610.0	179.8	216.9	202.8	184.3	182.4	171.2	217.9	130.0	243.0
Mean	252.6	385.0	401.8	204.1	185.8	171.5	173.7	186.3	178.2	206.6	186.1	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	6.2	7.3	20.7	**Red**	5.8	6.8	19.3	**Hill**	6.0	7.0	19.9
CD (0.05)		10.4	12.2	34.6		9.7	11.3	32.2		10.0	11.7	33.1

Table 10. Effect of fertilizer pellet pack and Nutripellet pack on available N (%) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	0.05	0.54	1.26	1.00	3.33	1.77	2.64	2.96	8.62	2.61	2.89	2.52
FPP - NP(SSP)K	0.07	0.70	0.70	1.15	2.02	1.03	1.74	0.78	1.24	0.84	1.88	1.11
FPP - NP(DAP)K (porous)	0.49	2.05	1.74	1.46	4.39	1.45	2.77	3.66	6.72	1.77	2.91	2.67
FPP - NP(SSP)K (porous)	0.09	1.18	0.54	1.49	1.21	0.96	2.38	2.32	2.12	1.66	1.54	1.41
NPP - NP(DAP)K	0.10	1.10	1.09	1.24	4.46	1.37	2.91	3.69	2.68	2.19	3.36	2.20
NPP - NP(SSP)K	0.14	1.07	0.53	1.28	1.59	0.72	2.43	1.18	1.18	1.26	1.93	1.21
NPP - NP(DAP)K(porous)	0.75	2.47	1.88	1.84	2.99	2.10	3.47	4.51	3.25	1.38	3.34	2.54
NPP - NP(SSP)K(porous)	1.05	1.60	1.14	0.87	3.97	1.45	2.05	2.38	10.58	1.59	2.74	2.67
Mean	0.34	1.34	1.11	1.29	2.99	1.36	2.55	2.68	4.55	1.66	2.57	
	Red soil											

FPP - NP(DAP)K	1.83	4.40	4.17	9.99	10.69	10.10	10.76	12.23	12.09	10.95	4.71	8.36
FPP - NP(SSP)K	1.23	2.33	2.72	16.55	5.52	7.56	5.41	3.84	5.97	7.73	7.44	6.03
FPP - NP(DAP)K (porous)	1.76	7.96	10.47	18.29	8.07	9.30	10.05	10.70	9.75	11.48	10.19	9.82
FPP - NP(SSP)K (porous)	1.85	4.50	7.37	14.37	9.33	8.79	10.75	9.68	9.60	10.50	8.00	8.61
NPP - NP(DAP)K	1.05	4.87	8.79	9.96	11.37	11.51	11.39	9.94	10.30	10.92	9.49	9.05
NPP - NP(SSP)K	1.26	2.52	4.42	19.07	7.11	8.45	5.12	6.70	7.48	9.40	7.37	7.17
NPP - NP(DAP)K(porous)	3.84	6.46	11.18	16.64	10.83	10.58	11.92	11.81	11.71	13.30	11.29	10.87
NPP - NP(SSP)K(porous)	1.23	3.89	8.65	15.49	9.74	12.15	11.28	11.40	10.97	9.08	5.01	8.99
Mean	1.76	4.62	7.22	15.05	9.08	9.80	9.58	9.54	9.73	10.42	7.94	
	Hill Soil											
FPP - NP(DAP)K	4.01	6.47	7.62	15.00	12.58	12.18	19.02	11.76	18.84	15.28	14.00	12.43
FPP - NP(SSP)K	3.75	4.85	4.79	23.96	11.98	8.91	11.04	14.03	11.32	11.26	9.86	10.52
FPP - NP(DAP)K (porous)	7.78	8.57	11.64	16.15	13.49	12.38	16.78	20.08	21.54	19.15	15.71	14.84
FPP - NP(SSP)K (porous)	4.36	6.67	8.31	21.09	9.69	11.46	14.59	14.50	16.18	12.99	12.30	12.01
NPP - NP(DAP)K	4.45	8.68	10.52	14.81	8.20	11.79	20.86	21.42	13.10	17.92	16.21	13.45
NPP - NP(SSP)K	4.92	5.97	6.00	19.91	8.42	7.81	13.38	12.54	10.25	13.52	9.08	10.16
NPP - NP(DAP)K(porous)	10.89	12.26	13.97	21.65	13.24	13.24	17.87	18.73	22.84	19.55	18.06	16.57
NPP - NP(SSP)K(porous)	4.04	7.86	7.23	23.74	9.50	10.34	15.28	15.87	19.57	18.92	14.51	13.35
Mean	5.52	7.67	8.76	19.54	10.89	11.02	16.10	16.12	16.70	16.07	13.72	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.09	0.10	0.28	**Red**	0.16	0.19	0.54	**Hill**	0.18	0.21	0.60
CD (0.05)		0.14	0.17	0.52		0.27	0.32	0.90		0.30	0.35	1.01

Table 11. Effect of fertilizer pellet pack and Nutripellet pack on available P (%) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	0.61	0.89	4.48	5.01	5.34	8.77	18.24	16.36	13.24	12.69	10.90	8.77
FPP - NP(SSP)K	0.53	0.72	0.89	3.46	1.24	3.05	4.18	2.50	2.11	3.45	3.51	2.33
FPP - NP(DAP)K (porous)	3.01	9.90	8.10	11.66	11.61	5.66	21.83	19.01	19.44	13.21	16.36	12.71
FPP - NP(SSP)K (porous)	1.51	3.16	1.69	5.35	0.99	6.59	11.54	17.52	7.10	8.47	5.71	6.33
NPP - NP(DAP)K	0.88	1.98	3.78	5.48	6.72	5.45	15.07	11.78	7.07	9.84	9.68	7.07
NPP - NP(SSP)K	1.43	0.85	1.44	8.85	1.27	3.42	3.67	1.81	1.56	3.43	2.75	2.77
NPP - NP(DAP)K(porous)	5.80	8.01	8.88	8.94	9.35	8.84	13.43	18.19	10.50	14.80	13.52	10.93

NPP - NP(SSP)K(porous)	2.81	4.40	3.92	2.11	2.56	8.35	8.12	4.96	3.93	6.65	5.01	4.80
Mean	2.07	3.74	4.15	6.36	4.89	6.27	12.01	11.52	8.12	9.07	8.43	
	Red soil											
FPP - NP(DAP)K	1.16	1.57	3.12	1.39	5.86	6.01	14.70	12.99	14.84	9.21	6.25	7.01
FPP - NP(SSP)K	0.78	0.94	1.72	4.53	1.01	2.12	2.67	3.08	1.78	2.76	3.55	2.27
FPP - NP(DAP)K (porous)	0.87	4.99	7.51	10.65	8.23	9.49	14.18	18.16	9.92	16.12	13.79	10.36
FPP - NP(SSP)K (porous)	1.22	2.93	5.48	2.22	4.00	6.69	11.48	5.11	4.76	7.88	4.02	5.07
NPP - NP(DAP)K	0.76	1.98	6.00	2.85	6.85	9.19	10.01	8.38	10.98	10.97	5.49	6.68
NPP - NP(SSP)K	0.70	1.09	1.40	4.96	2.50	3.08	7.43	2.11	2.93	3.81	4.35	3.12
NPP - NP(DAP)K(porous)	1.14	2.83	8.12	7.12	5.01	9.18	10.96	8.98	12.53	10.57	10.81	7.93
NPP - NP(SSP)K(porous)	0.94	2.33	6.75	5.32	2.50	4.70	9.98	11.54	7.16	7.34	1.70	5.48
Mean	0.95	2.33	5.01	4.88	4.50	6.31	10.18	8.80	8.11	8.58	6.25	
	Hill Soil											
FPP - NP(DAP)K	3.32	3.48	4.72	3.83	4.80	5.76	7.16	12.79	9.21	10.42	12.33	7.07
FPP - NP(SSP)K	2.62	2.58	2.28	4.77	1.64	5.60	13.13	6.68	2.61	4.84	5.15	4.72
FPP - NP(DAP)K (porous)	4.50	7.35	8.64	3.75	6.75	7.17	19.93	14.86	9.17	13.62	9.20	9.54
FPP - NP(SSP)K (porous)	3.26	3.88	4.73	7.17	3.05	6.52	13.93	8.52	6.60	8.35	10.12	6.92
NPP - NP(DAP)K	3.97	5.32	7.30	4.34	2.91	9.60	12.84	19.02	7.92	12.23	6.74	8.38
NPP - NP(SSP)K	3.28	3.20	2.58	4.92	2.42	7.25	20.42	7.28	4.57	2.75	2.64	5.57
NPP - NP(DAP)K(porous)	4.65	8.37	6.28	3.79	5.30	6.69	16.40	9.28	11.15	5.26	11.23	8.04
NPP - NP(SSP)K(porous)	3.46	5.29	2.86	8.19	2.23	4.82	4.33	6.94	6.92	3.67	6.45	5.01
Mean	3.63	4.93	4.92	5.10	3.64	6.68	13.52	10.67	7.27	7.64	7.98	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.19	0.22	0.63	**Red**	0.15	0.18	0.50	**Hill**	0.17	0.20	0.57
CD (0.05)		0.32	0.37	1.06		0.25	0.30	0.84		0.28	0.33	0.94

Table 12. Effect of fertilizer pellet pack and Nutripellet pack on available K (%) of sand, red soil and hill soil at weeks after incubation

WAI>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean**
Treatments	**Sand**											
FPP - NP(DAP)K	5.07	18.23	24.32	16.58	21.39	23.81	23.51	31.58	22.58	22.08	29.02	21.65
FPP - NP(SSP)K	4.94	17.11	23.66	27.24	27.70	24.94	27.57	22.99	20.59	25.48	22.74	22.27
FPP - NP(DAP)K (porous)	13.90	71.98	90.55	20.66	28.06	28.52	21.62	24.24	22.64	23.06	22.77	33.45
FPP - NP(SSP)K (porous)	6.23	74.19	48.45	23.98	28.03	24.22	27.07	20.36	19.86	24.20	22.86	29.04

NPP - NP(DAP)K	6.61	30.82	28.66	26.59	24.73	29.55	25.37	30.54	25.78	24.07	17.69	24.58
NPP - NP(SSP)K	6.45	28.08	32.66	28.60	27.89	23.46	17.70	21.33	30.27	25.60	23.61	24.15
NPP - NP(DAP)K(porous)	29.05	65.09	82.67	18.38	29.70	24.44	19.17	24.68	26.17	27.61	24.33	33.75
NPP - NP(SSP)K(porous)	13.19	73.84	86.49	19.99	16.85	26.24	26.13	20.74	17.23	27.95	25.08	32.16
Mean	10.68	47.42	52.18	22.75	25.54	25.65	23.52	24.56	23.14	25.01	23.51	
	Red soil											
FPP - NP(DAP)K	15.23	22.97	30.53	29.57	22.08	20.96	17.65	21.60	22.07	23.64	19.29	22.33
FPP - NP(SSP)K	9.25	28.31	30.38	29.28	23.15	30.10	22.45	22.68	26.10	21.57	22.59	24.17
FPP - NP(DAP)K (porous)	20.40	78.15	84.02	28.58	16.47	18.64	23.29	21.25	20.56	24.85	21.34	32.50
FPP - NP(SSP)K (porous)	12.51	77.40	88.76	21.20	23.98	22.97	20.92	16.66	16.99	23.99	21.14	31.50
NPP - NP(DAP)K	9.75	13.43	25.88	28.82	24.27	31.70	24.68	30.80	20.06	23.71	17.08	22.74
NPP - NP(SSP)K	12.32	17.07	21.60	29.71	27.48	14.64	24.94	31.04	30.27	23.34	21.83	23.11
NPP - NP(DAP)K(porous)	21.34	75.96	78.72	25.00	19.97	24.02	21.86	17.28	23.29	20.58	25.76	32.16
NPP - NP(SSP)K(porous)	11.21	79.29	81.78	25.43	21.15	22.99	18.24	23.88	18.80	27.06	29.23	32.64
Mean	14.00	49.07	55.21	27.20	22.32	23.25	21.75	23.15	22.27	23.59	22.28	
	Hill Soil											
FPP - NP(DAP)K	26.97	26.54	30.87	31.83	22.20	19.75	21.74	18.60	20.07	30.82	19.62	24.46
FPP - NP(SSP)K	29.22	22.73	30.40	30.07	22.36	24.35	17.06	31.87	22.46	22.22	24.87	25.24
FPP - NP(DAP)K (porous)	49.46	95.63	53.15	23.34	23.03	20.02	24.88	25.80	17.90	23.71	28.83	35.07
FPP - NP(SSP)K (porous)	28.59	84.85	89.43	26.13	24.70	19.24	22.27	24.70	20.48	20.97	19.33	34.61
NPP - NP(DAP)K	20.52	20.19	21.61	22.47	25.66	18.03	20.54	23.22	26.10	24.68	22.10	22.28
NPP - NP(SSP)K	29.18	13.69	14.74	21.68	22.04	17.62	16.57	17.07	27.32	30.34	26.54	21.53
NPP - NP(DAP)K(porous)	20.64	91.57	82.16	24.32	17.11	25.66	26.11	20.64	20.93	24.87	26.82	34.62
NPP - NP(SSP)K(porous)	45.50	25.97	75.49	22.26	26.85	25.10	22.81	22.58	21.19	26.96	16.09	30.07
Mean	31.26	47.65	49.73	25.26	22.99	21.22	21.50	23.06	22.06	25.57	23.03	
		T	P	T x P		T	P	T x P		T	P	T x P
SEd	**Sand**	0.77	0.90	2.55	**Red**	0.72	0.84	2.39	**Hill**	0.74	0.87	2.45
CD (0.05)		1.28	1.50	4.28		1.20	1.40	3.97		1.23	1.44	4.09

Fig. 4. Estimation of available nitrogen per cent from polycoat paper encapsulated fertilizer pack placed insand

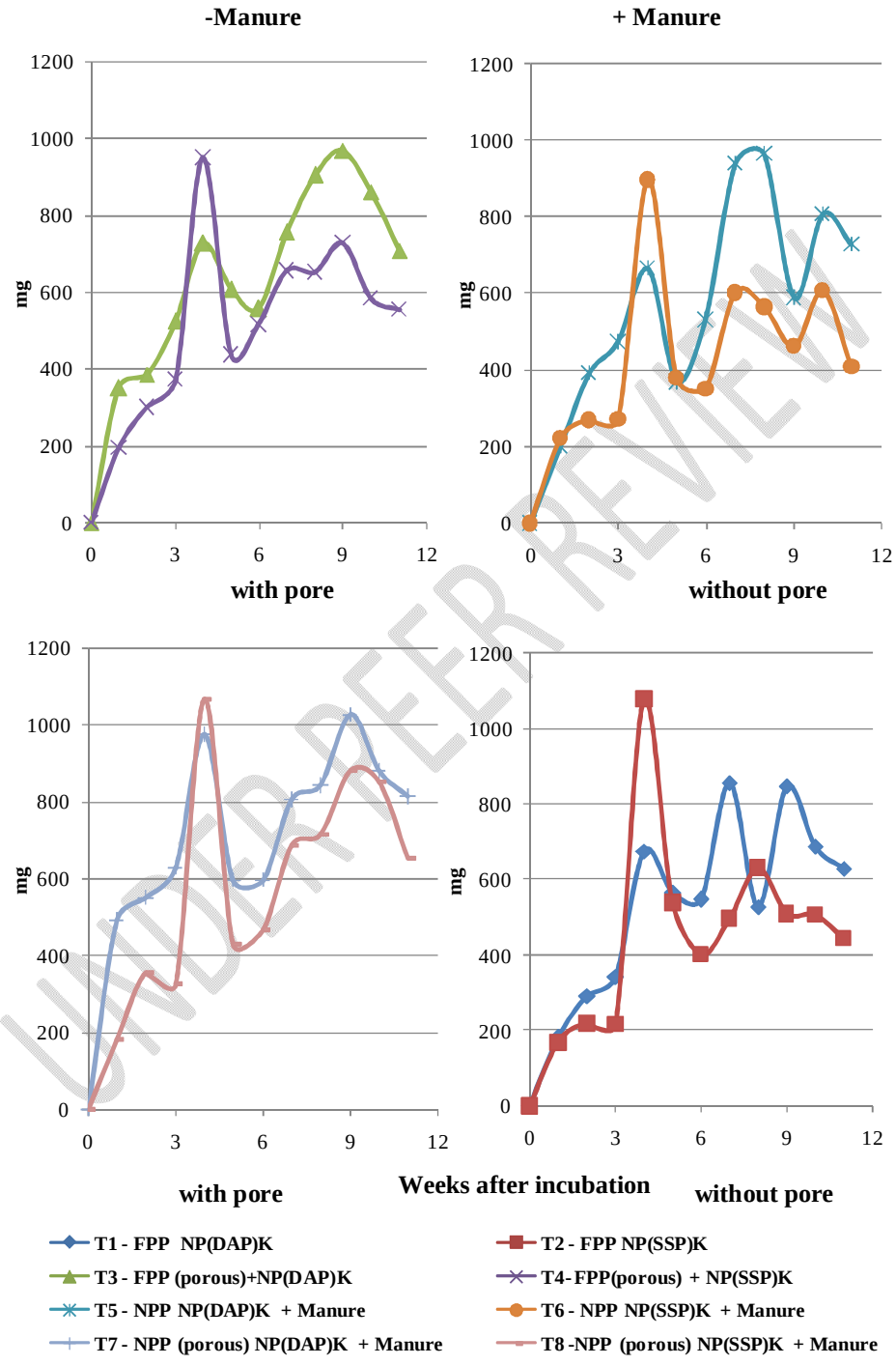


Fig. 5. Estimation of available nitrogen per cent from polycoat paper encapsulated fertilizer pack placed inred soil

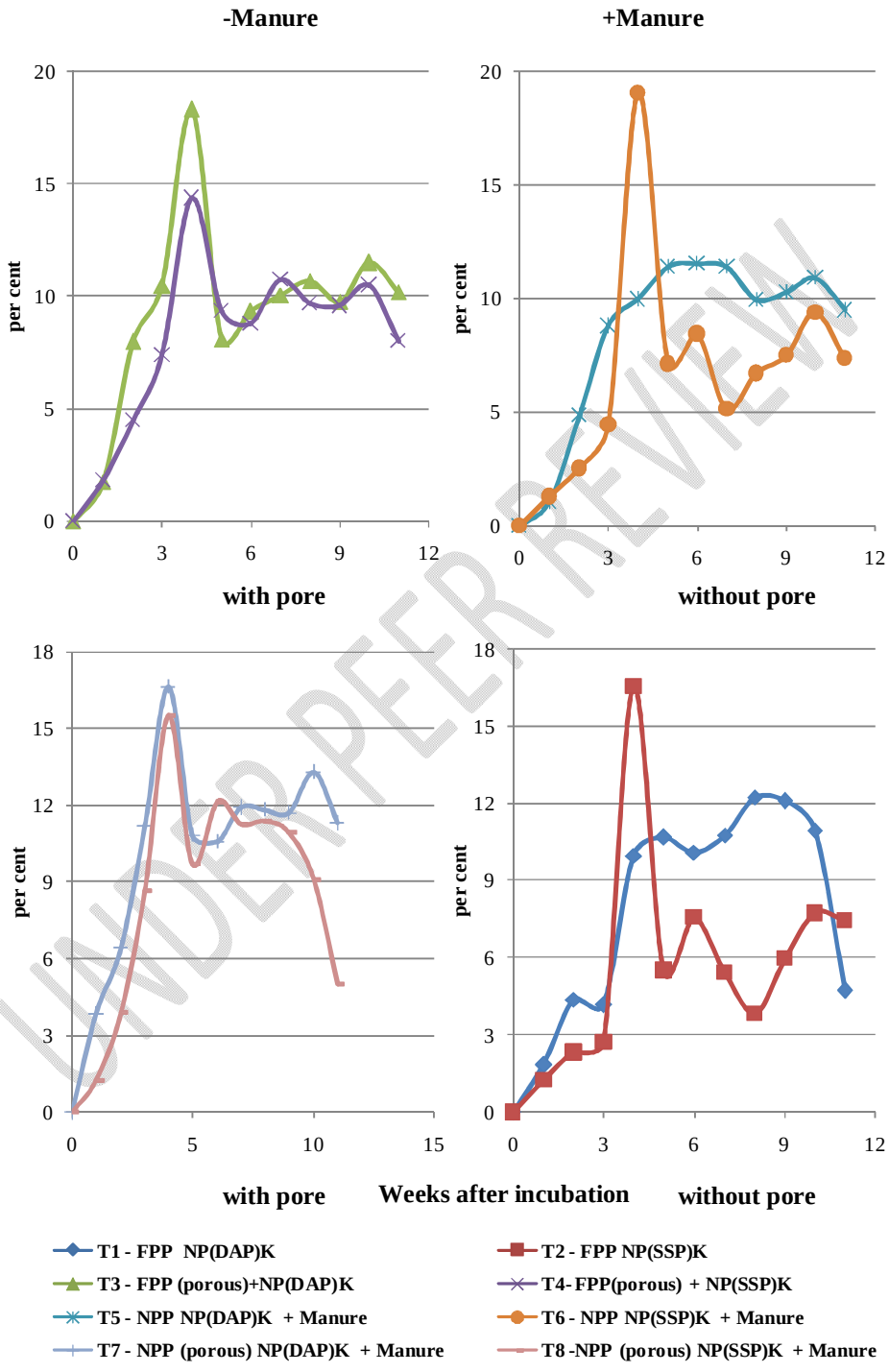


Fig. 6. Estimation of available nitrogen per cent from polycoat paper encapsulated fertilizer pack placed in hilly soil

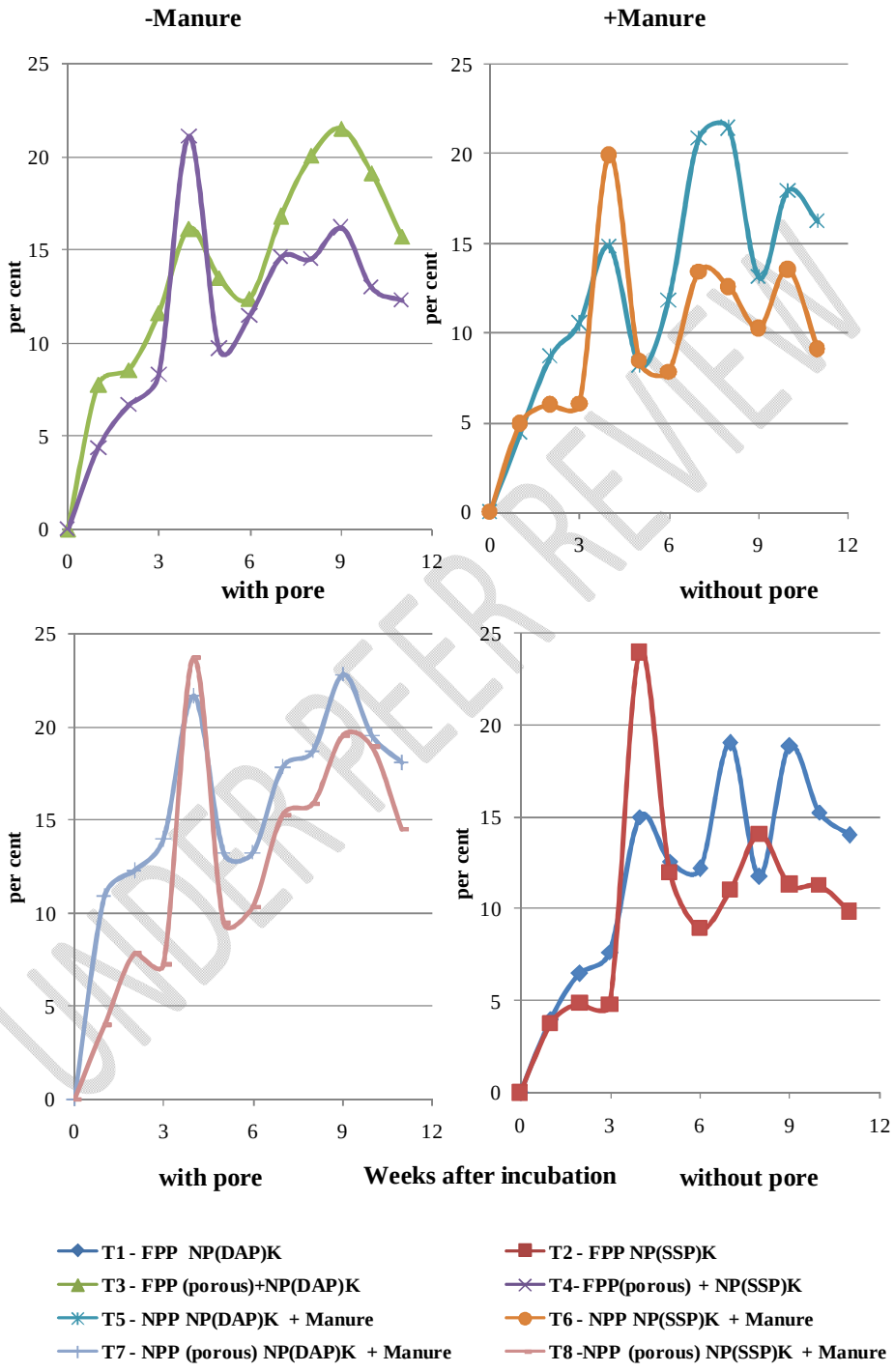


Fig. 7. Estimation of available phosphorus (mg) from polycoat paper encapsulated fertilizer pack placed in sand

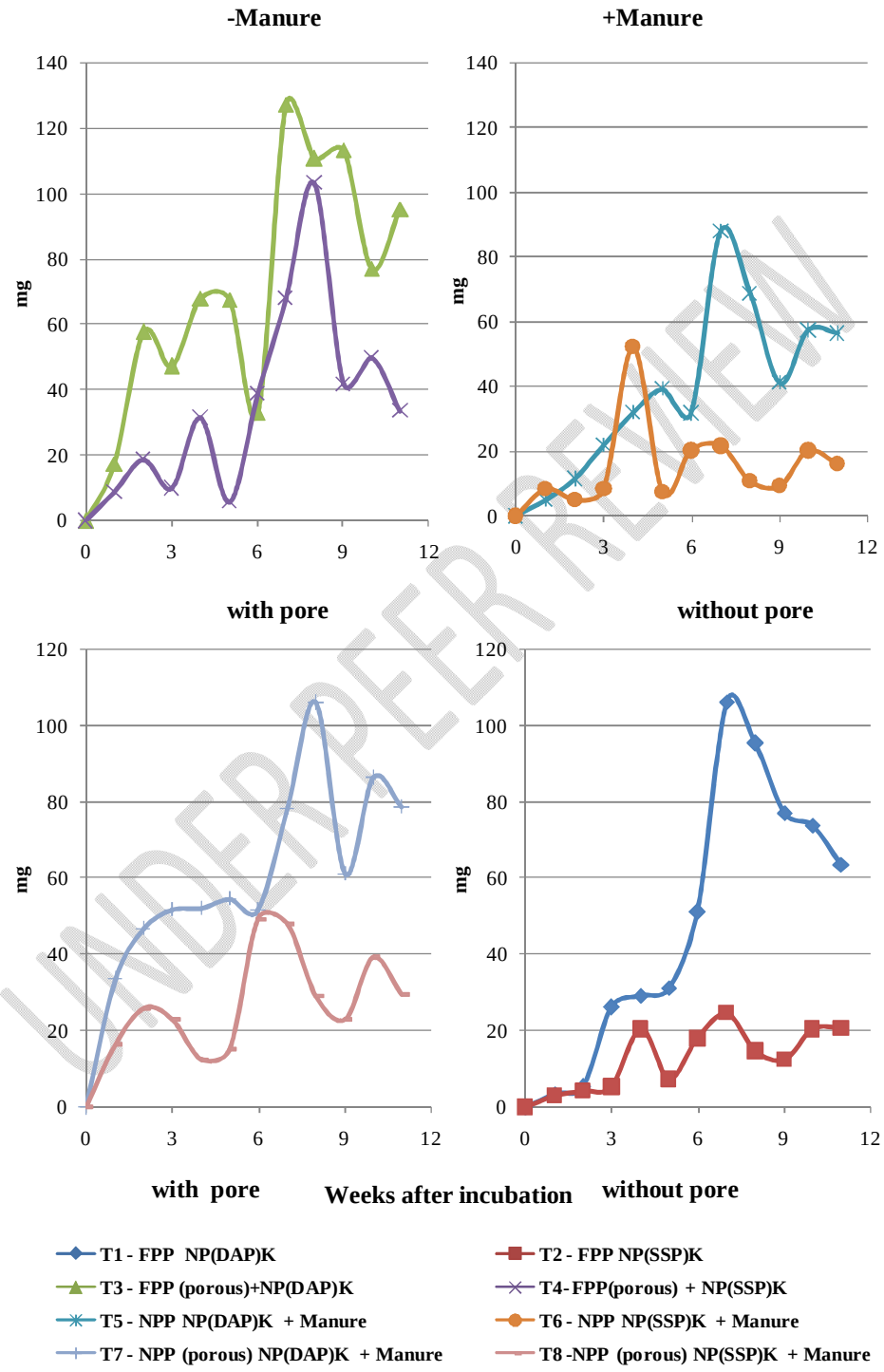


Fig. 8. Estimation of available phosphorus (mg) from polycoat paper encapsulated fertilizer pack placed in red soil

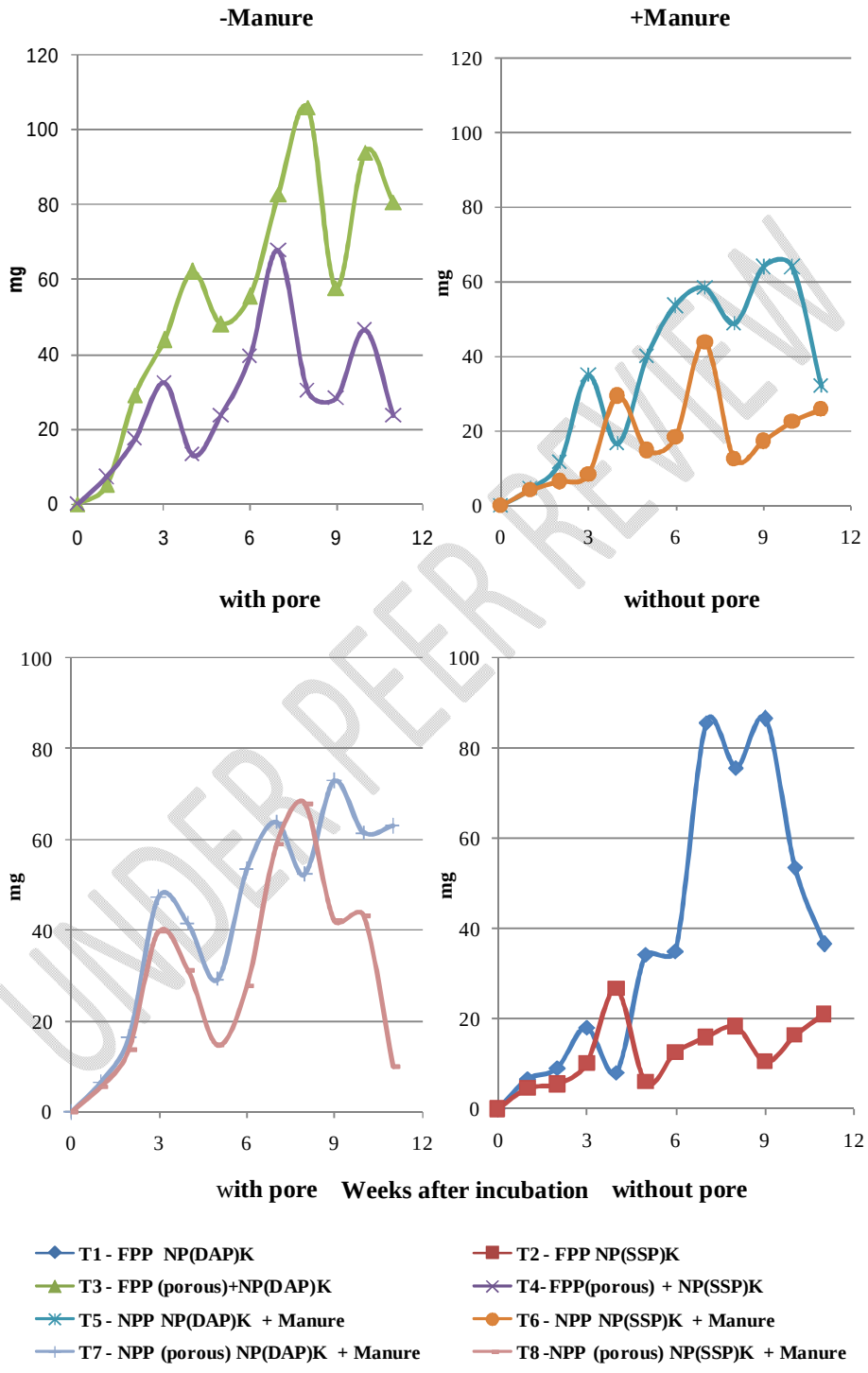


Fig. 9. Estimation of available phosphorus (mg) from polycoat paper encapsulated fertilizer pack placed in hilly soil

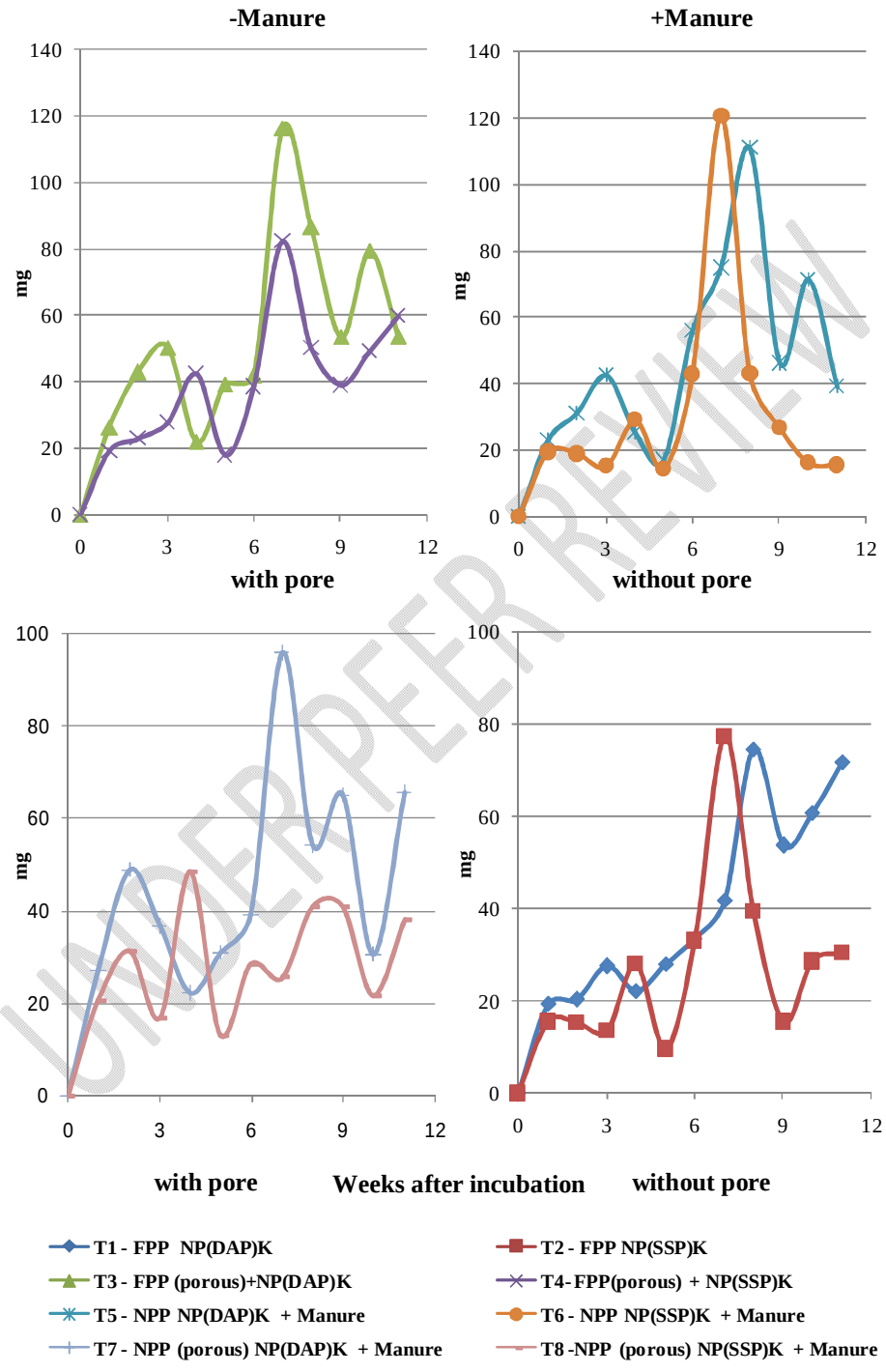


Fig. 10. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in sand

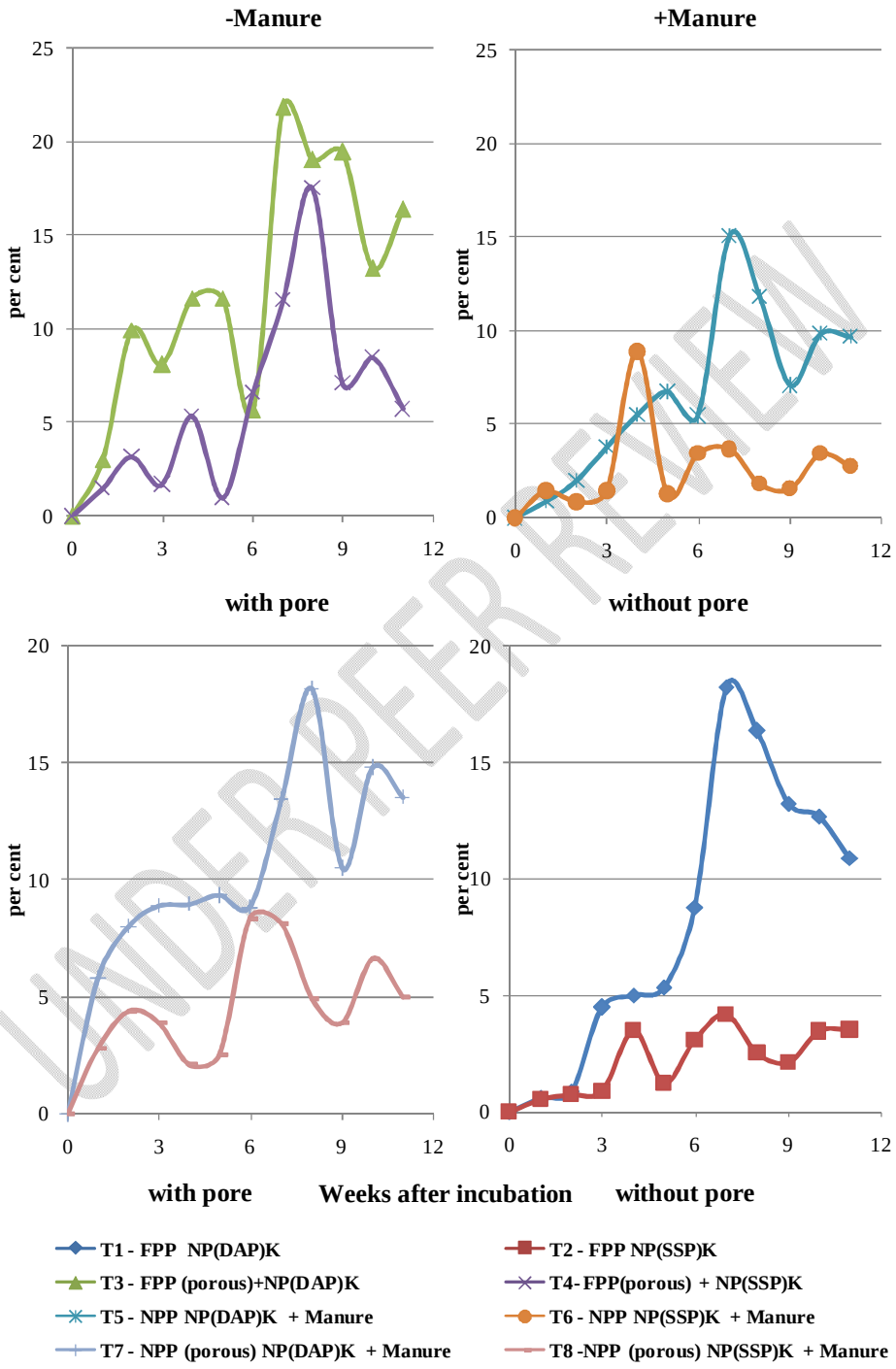


Fig. 11. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in red soil

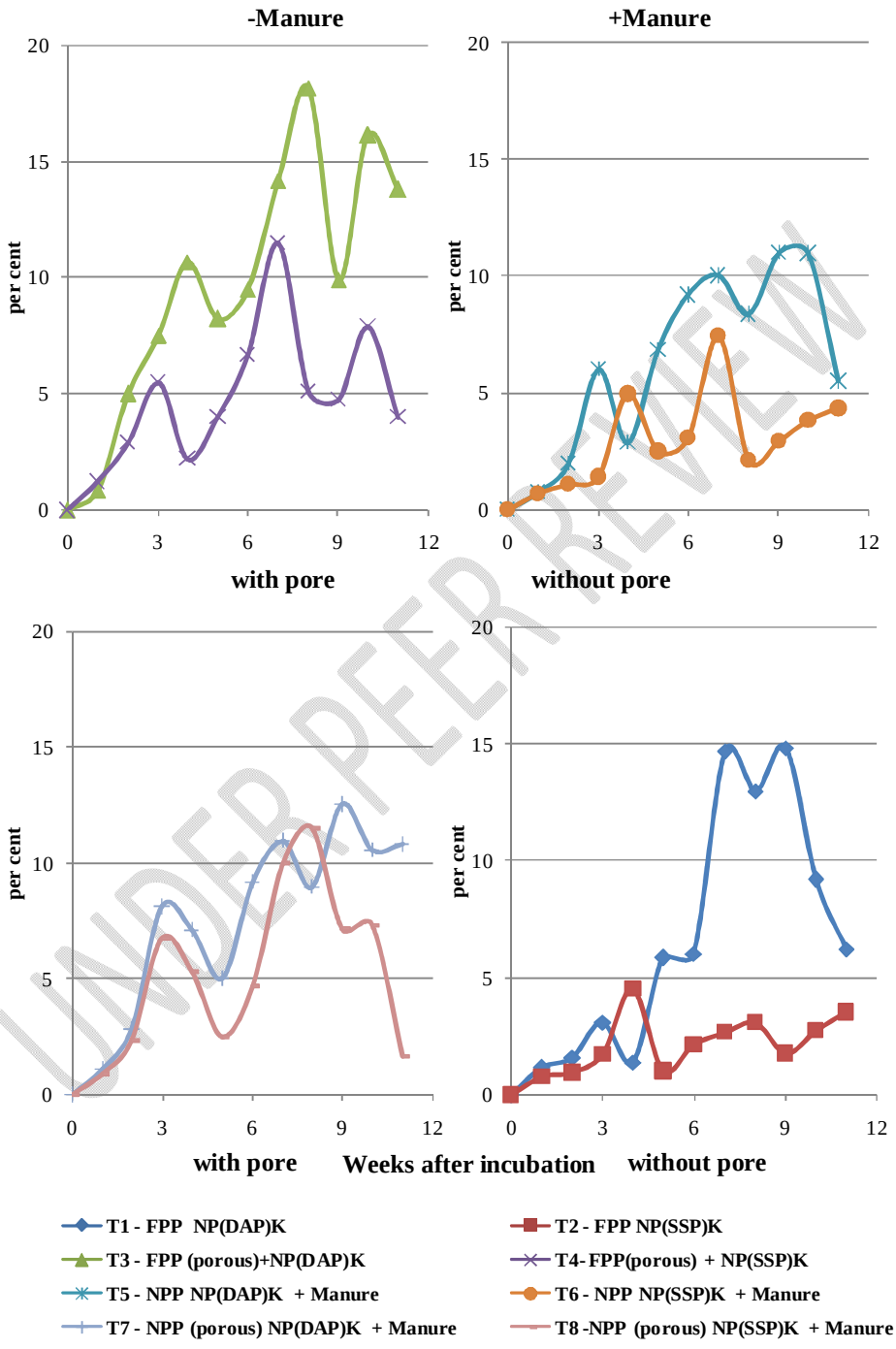


Fig. 12. Estimation of available phosphorus per cent from polycoat paper encapsulated fertilizer pack placed in hilly soil

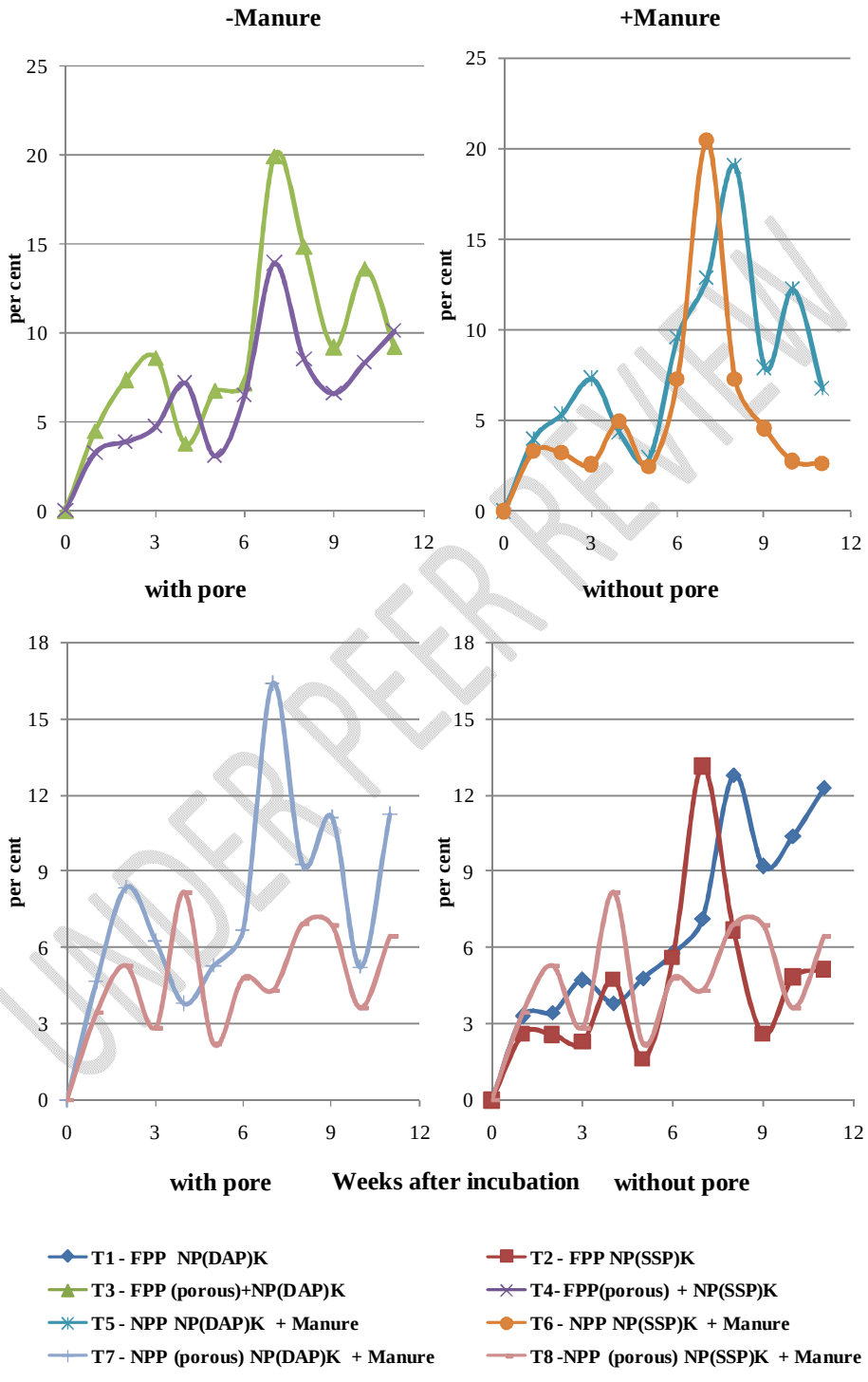


Fig. 13. Estimation of available potassium (mg) from polycoat paper encapsulated fertilizer pack placed in sand

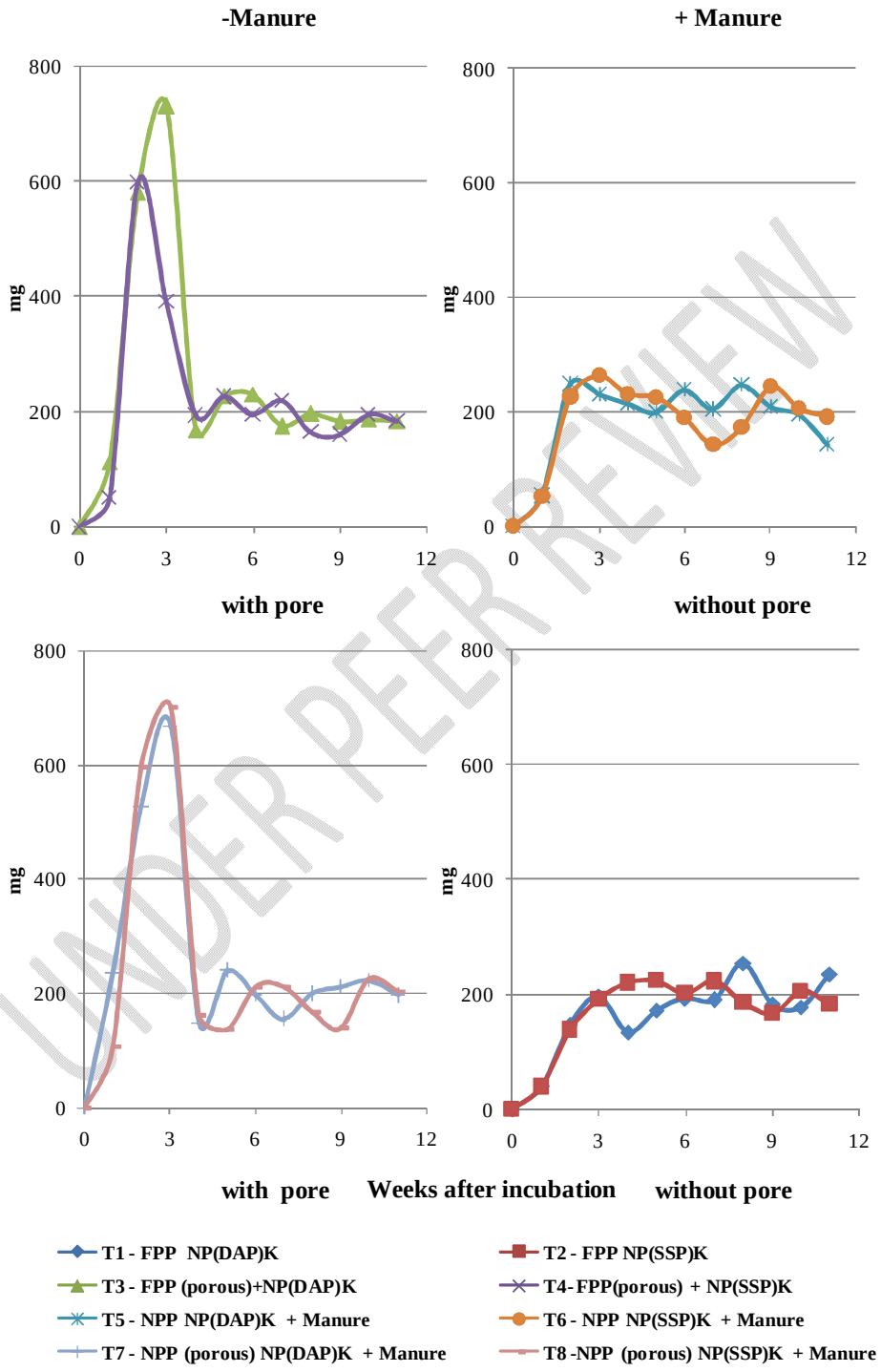


Fig. 14. Estimation of available potassium (mg) from polycoat paper encapsulated fertilizer pack placed in red soil

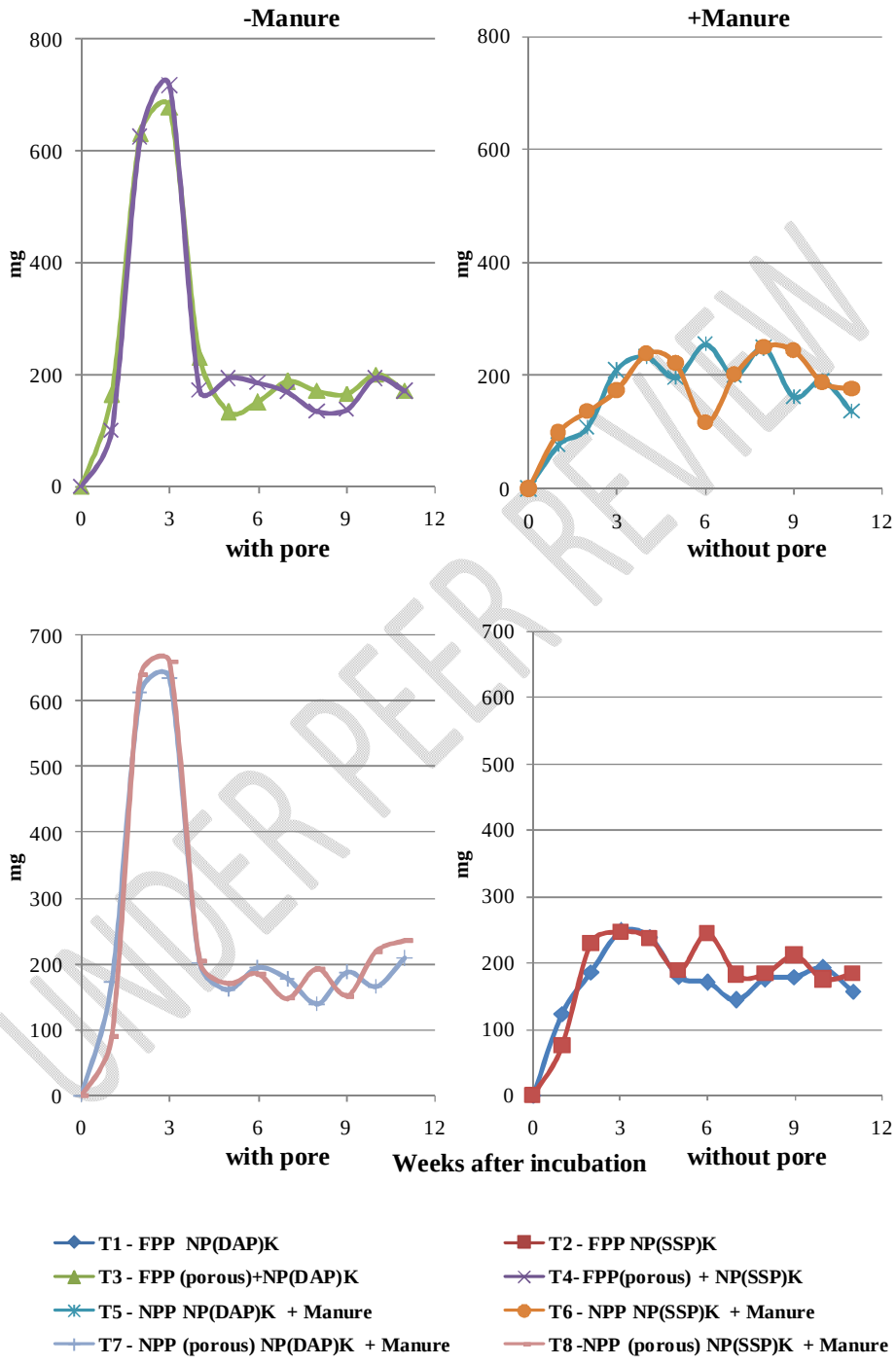


Fig. 15. Estimation of available potassium (mg) from polycoat paper encapsulated fertilizer pack placed in hilly soil

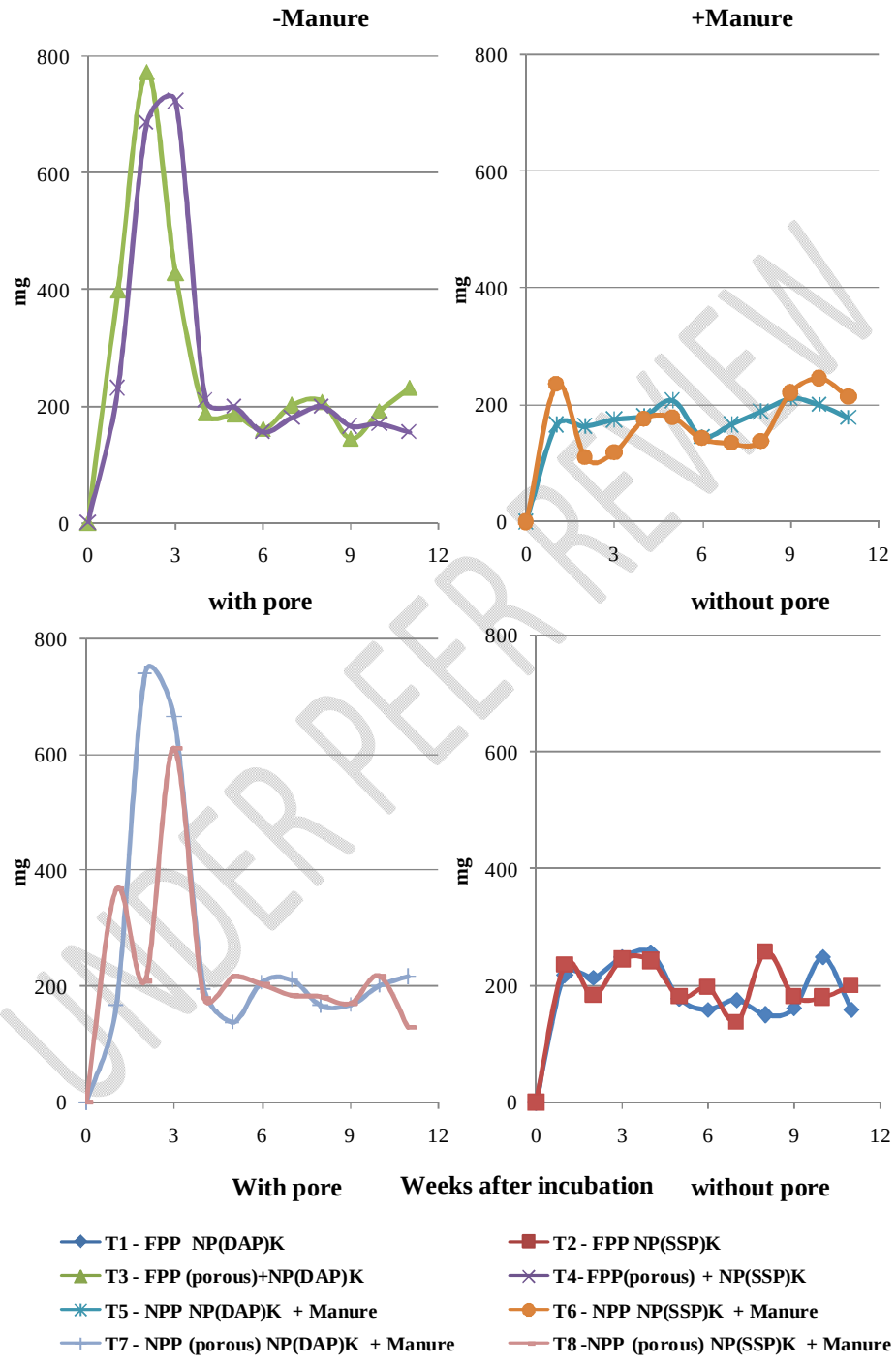


Fig. 16. Estimation of available potassiumper cent from polycoat paper encapsulated fertilizer pack placed in sand

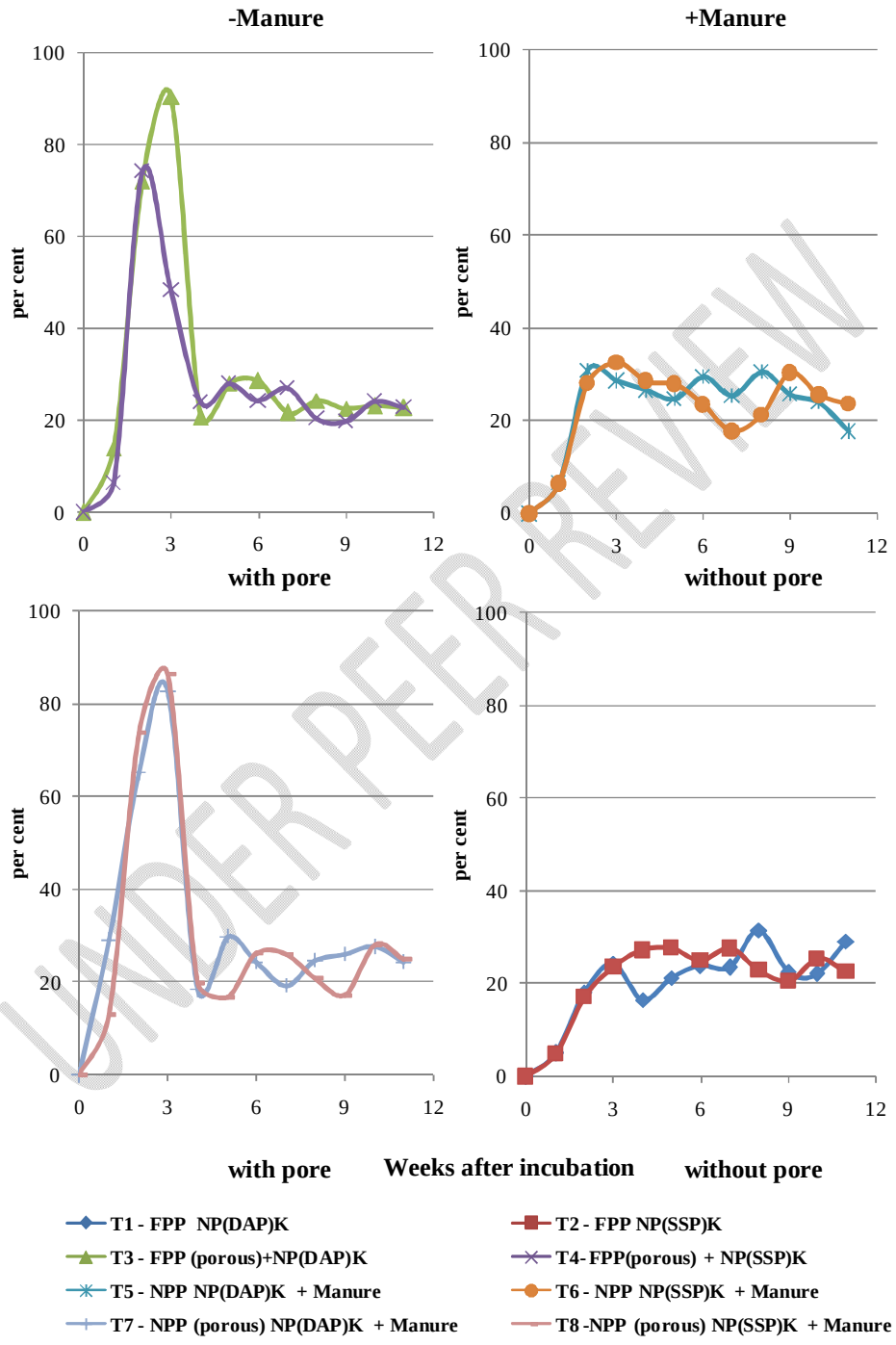


Fig. 17. Estimation of available potassiumper cent from polycoat paper encapsulated fertilizer pack placed in red soil

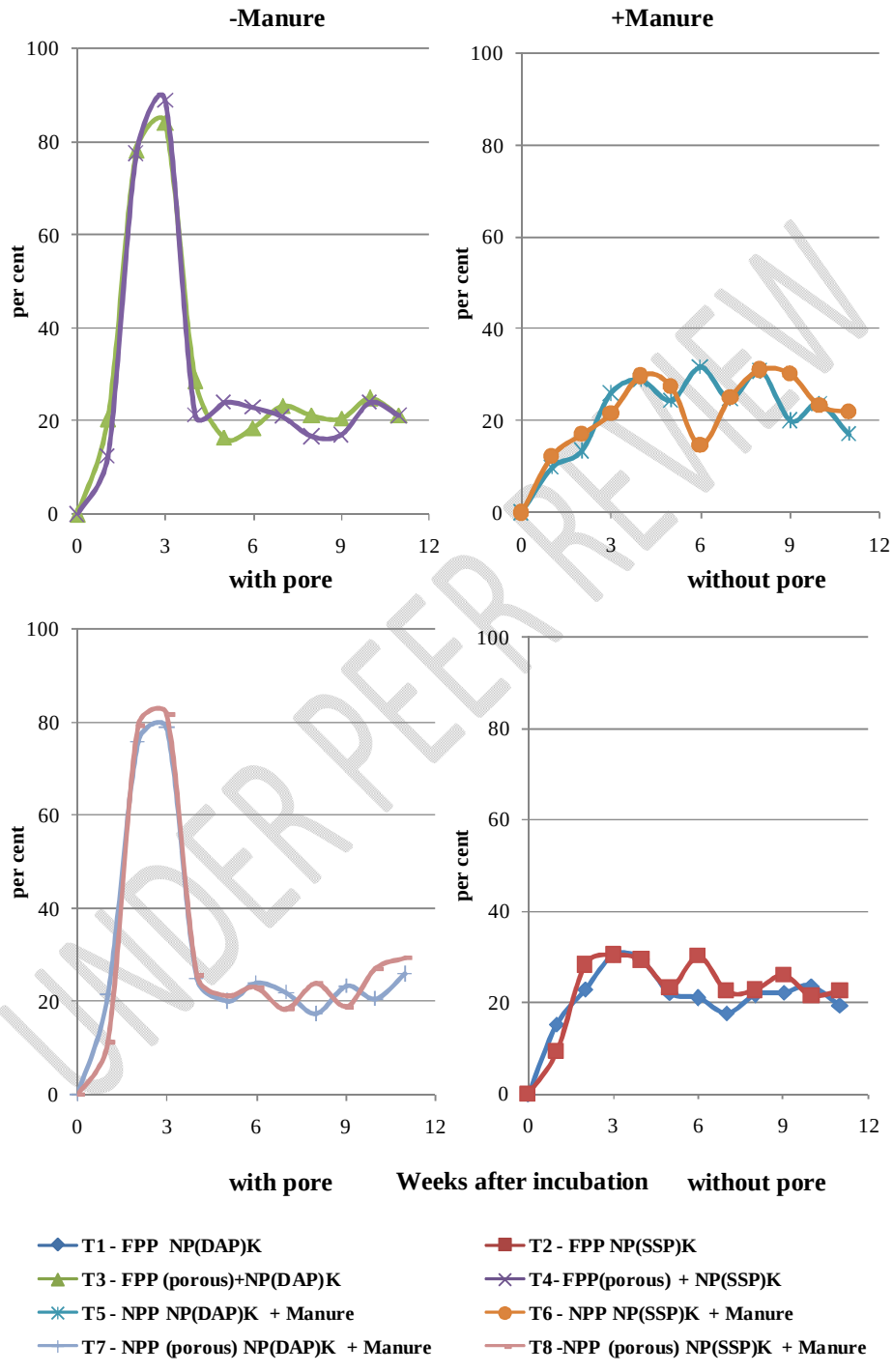


Fig. 18. Estimation of available potassiumper cent from polycoat paper encapsulated fertilizer pack placed in hilly soil