STUDIES ON THE PERFORMANCE OF TWO GROUNDNUT VARIETIES, TMV-2 AND TMV-9, UNDER GRADED DOSES OF PHOSPHORUS AND POTASSIUM

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "Studies on the performance of two groundnut varieties, TMV-2 and TMV-9, under graded doses of phosphorus and potassium" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

(N. PURUSHOTHAMAN NAIR)

Vellayani,
21st December, 1973.

CERTIFICATE

Certified that this thesis entitled "Studies on the performance of two groundnut varieties, TMV-2 and TMV-9, under graded doses of phosphorus and potassium" is a record of research work done independently by Shri. N. Purushothaman Nair, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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INTRODUCTION

INTRODUCTION

The importance of groundnut (Arachis hypogaea L.) needs no special emphasis as it is the world's second largest source of edible oil. Besides, groundnut kernel is considered as a rich and cheap source of high quality vegetable protein. It contains significant amounts of thiamin, riboflavin, nicotinic acid and vitamin E and has high calorific value. Appreciable quantities of minerals, such as phosphorus, calcium and iron are also present in the kernels. Inspite of the good nutritive qualities of groundnut kernel, the annual per capita consumption in India is estimated to be around two kilogram which is only 15 to 20 per cent of that consumed in other countries like U.S.A.

Groundnut is the most important oil seed crop of India contributing more than 60 per cent of the total oil seeds production in the country. It occupies nearly 7.5 million hectares with an annual production of about 6.5 million tonnes of pods which accounts for about 40 per cent of the world's total production. However the average yield of groundnut in India, is very low compared to that of many other groundnut growing countries of the world.

Apart from the domestic consumption, India exports groundnut in the form of kernels and deoiled cake and earns about rupees 70 to 80 crores as foreign exchange annually (Patil, 1977).

During the year 1975-76, a record production of about 7 million tonnes of pods was harvested resulting in an increased per capita availability of groundnut from 2 to 2.5 kg. Inspite of this, the country is currently facing an acute shortage of edible oil probably due to its increased use for industrial purposes (Patil, 1977). This calls for immediate steps to augment groundnut production to ease the situation. The only possibility of increasing production is by intensive cultivation and thereby increasing the yield per unit area.

In Kerala, groundnut is cultivated in nearly 17,510 hectares and the annual production is about 23,148 tonnes with an average yield of 1,322 kg pods per hectare (Anon. 1977). Lack of suitable new high yielding strains combined with proper cultural and manurial recommendations for Kerala has resulted in the present low average yield in the State. Therefore, in order to increase production, it is essential to introduce high yielding, better adaptable short duration varieties with scientific cultivation practices based on varietal and manurial experiments.

TMV-2 is one of the bunch varieties of groundnut grown in this State. Another recently released short duration bunch variety, TMV-9, has out yielded TMV-2 in trials conducted in Tamilnadu. However, the performances of these two varieties under the agroclimatic conditions of Kerala have not been studied so far.

The groundnut crop removes fairly large amounts of nutrients from the soil. It is reported that a crop of groundnut producing 2245 kg of pods and 4490 kg of haulms removes 156.60 kg nitrogen, 27.24 kg P_2O_5 and 115.46 kg K_2O per hectare (Seshadri, 1962). Cultivation of groundnut will, therefore, deplete the soil unless the crop is adequately manured, although it is capable of fixing atmospheric nitrogen. Phosphorus has been recognised as a constituent of nucleic acid, phytin and phospholipids and an adequate supply of phosphorus early in the life of the plant is important in putting forth the primordia for its reproductive parts and for increased root growth. The response of phosphorus varies with the soil (Gopalakrishnan and Nagarajan, 1958). Groundnut is considered as a heavy feeder of potassium. An assessment of available potassium status in Indian soils showed that about 50 per cent of soils in Kerala were low in potassium status and the remaining area were medium (Ghose and Hassan, 1977). Therefore, supply of optimum levels of potassium for our soils is highly indispensable to harvest a good crop of groundnut.

Although studies have been made on the independent effect of phosphorus and potassium on groundnut, very little information is available on the combined effect of these nutrients in various combinations under the agro-climatic conditions of Kerala. Therefore, it was thought worthwhile to conduct an experiment with the following objectives:

1. To study the performance of the groundnut variety TMV-9 in comparison with TMV-2 under the agro-climatic conditions of Kerala.

2. To investigate the effects of graded doses of phosphorus and potassium on these varieties and to find out the optimum doses of these nutrients for the two varieties.

3. To assess the influence of different levels of phosphorus and potassium on the quality of groundnut kernels and

4. To work out the economics of phosphorus and potassium nutrition in groundnut crop.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The importance of phosphorus and potassium on the growth and yield of groundnut was brought out by many experiments conducted in India and abroad. Some of the works conducted on the influence of these nutrients on the growth characters, nitrogen fixation, yield and yield attributes, qualities of kernel, chemical composition and nutrient uptake are briefly reviewed hereunder.

1. Effect of phosphorus on growth characters.

Harris (1949) studying on the effect of nutrient deficiencies in the root and pegging zone observed that the lack of phosphorus in the nutrient solution reduced top growth and total growth of peanut plant. Deficiency symptoms due to the withholding of phosphorus from the roots of groundnut plants were recorded by Bledsoe and Harris (1950). They observed that the top growth was greatly restricted and in the later stages there was premature de-foliation of basal leaves.

Macro nutrient studies in Tamilnadu showed that phosphorus deficiency depressed height of plants to a considerable extent and limited the leaf area to a great extent (Gopalakrishnan and Nagarajan, 1953). Wahab and Mohammed (1958) observed increased hay yield due to phosphorus fertilization. Phosphorus deficiency decreased dry weight of both tops and roots (Reid and York, 1958). Bunting and Anderson (1960) noted that phosphorus fertilization increased growth rate and deposition of kernel material. They also found that fertilized plant accumulate more dry weight in vegetative parts than the unfertilized plants.

Nijhawan (1962 b) found that the application of phosphorus ensured good growth of plants. Experiments conducted at Agricultural College Farm, Nagpur showed significant increase in the number of branches by higher levels of phosphorus (Puntamkar and Bathkal, 1967). Punnoose (1968) noted significant increase in height of plants with increase in the levels of phosphorus from 0 to 100 kg P_2O_5 per hectare. He also found that the number of leaves per plant were progressively increased with increased levels of phosphorus. Increase in vegetative growth and fruiting by phosphorus application was also reported by Singh and Patnak (1969). Bhan and Misra (1970) found increased development of roots with increase in levels of phosphorus. The response of higher levels of phosphorus in increasing the height of plants was recorded by many workers like, Jayadevan (1970), Palaniappan (1970) and Muraleedharan (1971). Bhan and Misra (1972) obtained rapid and increased growth of plants with phosphorus application. Application of higher doses of phosphorus increased the number of branches in groundnut (Dholaria and Joshi, 1972). Bhan (1977) observed that nitrogen and phosphorus application singly and in combination gave a higher dry matter production by vegetative parts.

2. Effect of phosphorus on nodulation and nitrogen fixation.

The beneficial effect of phosphorus nutrition on nodulation of leguminous plants is well recognised. Mijnawan (1962 b) reported that the requirement of phosphorus was very low as compared to nitrogen but it was very important for the development of pods and for nitrogen fixation. Verma and Bajpai (1964) in a review on mineral nutrition concluded that nodulation was completely checked by absence of phosphorus. The response of P_2O_5 in increasing the yield is substantiated as might be due to the effect of phosphorus in stimulating the nitrogen fixation in addition to its direct effect on the morphological characters of the plant (Banerjee et al., 1967). Khare and Rai (1968) found that phosphorus played a remarkable role in the symbiotic fixation of nitrogen. Increased activity of nodular bacteria due to phosphorus levels was also observed by Puri (1969). Experiments conducted in Tamilnadu by Nair et al. (1970) revealed again that the number of nodules produced was significantly reduced due to lack of phosphorus. Significant increases in the number of root nodules and in their nitrogen content in response to P application were observed by Bhan and Misra (1970). Similar results were reported by Jayadevan (1970), Muraleedharan (1971) and Muthusamy (1973).

In a trial conducted in red loam soils of Kerala, Punnoose and George (1975) found that application of nitrogen reduced the mean number and dry weight of nodules but phosphorus levels upto 100 kg P_2O_5 per hectare progressively increased both. Pawar and Khupse (1976) studied the nodulation pattern in groundnut as influenced by levels of phosphorus (20, 40 and 60 kg P_2O_5 per hectare) and concluded that nodulation was increased up to the highest level (60 kg) of P_2O_5.

3. Effect of phosphorus in yield and yield attributes.

It was found that nutrient solution deficient in phosphoric acid significantly reduced the mean number of mature pods (Bledsoe and Harris, 1950). Gopalakrishnan and Nagarajan (1958) found that flower production and fertilization of flowers were adversely affected by lack of phosphorus. They also observed that phosphorus was a limiting factor in the yield of groundnut. A significant reduction in the reproductive branches, flowers and pegs by the absence of phosphorus was observed by Reid and York (1958). They further reported that the plants absorbed sufficient quantities of phosphorus prior to flowering stage so as to complete their growth.

Rao and Govindarajan (1960) reviewed the manurial experiments conducted in Karnataka State for the past thirty years and concluded that groundnut responded well to the application of phosphorus. Application of phosphorus gave as much increase in yield as nitrogen alone or that in combination with phosphorus (Nijhawan, 1962 b). Seshadri (1962) based on experiments carried out in Tamilnadu reported that phosphorus at 45 kg and 60 kg P_2O_5 per hectare gave best results under rainfed and irrigated conditions respectively. Phosphorus increased the number of flowers and pods per plant besides increasing the yield of pods per hectare and the shelling percentage (Sathyanarayana and Rao, 1962). Favourable effects of phosphate application in increasing the yield of pods were also reported by Pathak and Verma (1964). Reddy and Rao (1965) noticed that 22.42 kg P_2O_5 per hectare gave increased yield and this level was found optimum for groundnut. On the other hand, Katarki and Banahatti (1965) found significant responce for higher levels of phosphorus. They observed that 112 kg P_2O_5 per hectare gave significant increase in yield over that by 56 kg P_2O_5 per hectare. Reviewing about 200 trials conducted on groundnut under different types of soils, Mann (1965) concluded that on an average 33.6 kg P_2O_5 per hectare gave the best results in pod yield. An experiment with 0, 33.6 and 67.2 kg P_2O_5 per hectare under lateritic soil condition in West Bengal showed that high yield was associated with higher doses of phosphorus (Banerjee et al., 1967). Significant response of groundnut to phosphorus application at 80 kg P_2O_5 was reported from experiments in Andhra Pradesh (Kulkarni et al., 1967). Similar increases in yield of groundnut by phosphate nutrition were also reported by Bodade and Rao (1967) and Puntamkar and Bathkal (1967). Patel (1968) inferred from an experiment conducted in Gujarat that higher levels of phosphorus significantly increased the yield and 44.8 kg P_2O_5 per hectare was the economic dose for the crop in sandy soils of Gujarat.

Studies conducted in the black soils of Andhra Pradesh showed that application of phosphorus upto 67.26 kg P_2O_5 per hectare gave significant increase in yield (Naidu, 1968). Acuna and Sanchez (1968) found that groundnut yields were mainly limited by phosphorus supply and 80 kg P_2O_5 per hectare was found adequate. Studies on plant density and fertilizer response showed that groundnut crop with high plant densities responded to application of 100 kg P_2O_5 per hectare (Herrera et al., 1969). Puri (1969) reported that phosphorus was found to be a limiting factor in yield of groundnut and its deficiency seriously reduced flower production and affected the size of pods. An application of 22.5 kg P_2O_5 per hectare resulted in an yield increase of 57 per cent over control in manurial experiments conducted at Thabua in Madhya Pradesh (Singh and Pathak, 1969). They further noticed that the growth of plants and fruiting were increased with the application of phosphorus.

Experiments at Amravathi in Maharashtra with different doses of phosphorus showed that the highest level of phosphorus (50.62 kg P_2O_5 per hectare) was superior in the production of pods than other levels (Bodade, 1970). Tella et al. (1970) observed that phosphorus upto 90 kg P_2O_5 per hectare markedly increased yields on podzolised soils in Sao Paulo. In a study on the influence of the phosphorus and sulphur, Palaniappan (1970) found that increased doses of phosphorus increased flower production and pod yield of variety TMV-7. He also found that haulm yield was not affected by phosphorus application.

Muraleedharan (1971) studying the effect of phosphorus on groundnut in red loam soils of Vellayani found that phosphorus at 75 kg P_2O_5 per hectare significantly increased the number of pods per plant, weight of mature pods per plant, yield of pods per hectare, natural test weight and shelling percentage. He also observed that the yield of haulm was highest by the application of 100 kg P_2O_5 per hectare and the percentage of pegs developed into mature pods significantly decreased by higher levels of phosphorus. Increases in pod yields up to 90 kg P_2O_5 per hectare were also reported from experiments conducted at Rajendranagar (Kumar and Venkatachari, 1971). Bhan and Misra (1972) reported that a better growth of plant was obtained with combined application of nitrogen and phosphorus. They also observed that flowering was earlier by 4.2 to 4.4 days in fertilized plots compared to unfertilised plots. Muhammed et al. (1973 b) reported that in irrigated conditions, variety TMV-7 gave a linear increase in yield of pods by application of phosphorus upto 44.92 kg P_2O_5 per hectare. Yield increase with P_2O_5 application upto 40 kg per hectare was also reported from Ludhiana (Saini et al., 1973).

Simple fertilizer trials in different parts of the country showed remarkable influence of phosphorus on the yield of groundnut at levels upto 80 kg P_2O_5 per hectare (Mahapatra et al., 1973). Nakagava et al. (1974) observed significant increase in yield of unshelled nuts by application of phosphorus upto 115 kg P_2O_5 per hectare. Increased peg formation and 1000 seed weight by application of phosphorus in combination with nitrogen was reported by Georgiev (1974). Punnoose and George (1974) recorded maximum pod yield by a combination of 10 kg nitrogen and 75 kg phosphorus per hectare, in red loam soils of Kerala. Response to phosphorus fertilisation was also reported by Chesney (1975) who found that application of the entire phosphorus at planting produced higher yields than split application. Dahatonde and Rahate (1975) observed that phosphorus application significantly increased the yield of dried pods, yield of haulm, number and weight of pods per plant, shelling percentage and test weight. Joshi et al. (1975 a) also observed beneficial effect by phosphorus fertilization upto 40 kg P_2O_5 per hectare. An experiment conducted by using the variety Asiria mwitunde showed that phosphorus application upto 75 kg P_2O_5 per hectare progressively increased the number of pods per plant, weight of pods per plant, 100 pod weight, 100 kernel weight, shelling percentage, percentage of two seeded pods, natural test weight and yield of pods per hectare (Jayadevan and Sreedharan, 1975). Significant increases in yield of groundnut upto 60 kg P_2O_5 per hectare were also reported by Joshi et al. (1975 b). Muraleedharan et al. (1975) reported that application of 50 kg P_2O_5 per hectare significantly reduced pre-blossom period and decreased the percentage of pegs developed to mature pods. Significant improvement in shelling outturn and 100 pod weight by application of higher levels of phosphorus was also noticed by Saini and Tripathi (1975).

Saini and Tripathi (1976) concluded from varietal cum manurial trials in Ludhiana for three kharif seasons that phosphorus application at 40 kg P_2O_5 per hectare significantly increased the pod yield over the lower level. Experiments under dry farming conditions with phosphorus levels 0, 40 and 80 kg P_2O_5 per hectare showed that phosphorus at the rate of 80 kg P_2O_5 per hectare gave significantly higher yield over the other levels (Kulkarni et al., 1977). Bhan (1977) observed that while, application of nitrogen increased the yield of haulm, phosphorus application increased the yield of kernel over that of control.

While majority of literature showed favourable effects of phosphorus application in groundnut, Jayachandran et al. (1973) reported that trials at Tindivanam consistantly failed to bring out any significant increase in yield of pods at higher levels of phosphorus.

4. Effect of phosphorus on the quality of kernel.

Nearly, 75 per cent of groundnut kernel is comprised of oil and protein. Phosphorus is found in large quantities in seeds and is considered essential for seed formation. It is recognised as a constituent of nucleic acid, phytin and phospholipids (Tisdale and Nelson, 1975).

(a) Effect of phosphorus on the protein content of kernel.

Nijhawan (1962 a) and Puntamkar and Bathkal (1967) reported that phosphorus markedly increased the protein content of kernels of groundnut. It was reported that phosphorus levels upto 100 kg P_2O_5 per hectare progressively increased the protein content of kernels (Punnoose, 1968). Similar results were also reported by Omueti and Oyenuga (1970). They found that crude protein in groundnut was increased by 35 per cent by the application of phosphorus at 44 kg P_2O_5 per hectare as compared to no phosphorus. Jayadevan (1970) observed a progressive increase in protein content of kernels by the application of phosphorus at different levels upto 100 kg P_2O_5 per hectare. Similar results were also obtained by Arora et al. (1970) and Muraleedharan (1971). Application of phosphorus upto 90 kg P_2O_5 per hectare increased protein content in Asiriya mwitunde and Spanish Improved varieties of groundnut (Kumar and Venkatachari, 1971). Significant increases in the protein content of kernels by phosphorus application were observed at Brahmaputra flood-plain soils by Bhuiya and Chawdhury (1974).

However, Palaniappan (1970) found that phosphorus had no effect on protein content of kernels.

(b) Effect of phosphorus on oil content.

Nijhawan (1962 a) reported that the application of nitrogenous and phosphatic fertilizers which increased the yield considerably had no effect on the oil percentage of seed and therefore the oil produced per hectare might be directly related to the yield obtained by the application of the fertilizers.

Sathyanarayana and Rao (1962) reported that nitrogen and phosphorus application increased the oil content of groundnut kernels. In trials with variety TMV-2 at Vellayani, Punnoose (1968) observed that nitrogen application had significantly reduced the oil content of kernels, while phosphorus had significantly increased the oil content with increasing doses upto 100 kg P_2O_5 per hectare. Jayadevan (1970) also observed similar results in experiments on variety Asiriya mwitunde. Palaniappan (1970), Yadav and Singh (1970), Kumar and Venkatachari (1971) and Muraleedharan (1971) also recorded increase in oil content by phosphorus fertilization. Bhuiya and Chawdhury (1974) observed that phosphorus at the rate of 67.2 kg P_2O_5 per hectare increased the percentage of oil in groundnut kernel. Considerable improvement in oil content of kernel due to higher levels of phosphorus was also reported by Saini and Tripathi (1975).

On the other hand, Puntamkar and Bathkal (1967) observed that phosphorus as well as nitrogen did not affect the oil content of kernels.

5. <u>Effect of phosphorus on chemical composition and total uptake of nutrients.</u>

Bledsoe and Harris (1950) observed that the leaves of plants which were grown with nutrient solution deficient in phosphorus contained significantly lower percentage of nitrogen, phosphorus and potassium. They found that phosphorus and potassium contents of shells of these plants were also significantly decreased. A groundnut crop with an average pod yield of 2376 kg per hectare removed 25 kg P_2O_5 per hectare and the phosphorus requirement was very low as compared to other nutrients such as nitrogen and calcium (Nijhawan, 1962 b). Verma and Bajpai (1964) reviewed the mineral nutrition of groundnut in relation to its growth, yield and quality and concluded that the average crop removal of phosphorus varied widely. They reported that in Egypt, it was 58.94 kg P_2O_5 per hectare and in Senegal 32.8 kg P_2O_5 per hectare. Puntamkar and Bathkal (1967) found that higher level of phosphorus has increased the nitrogen uptake as compared to lower level of phosphorus. The highest total removal of nitrogen through pods and hay was found to be 42.66 kg and 14.60 kg per hectare respectively. They further observed that phosphorus application increased the total uptake of phosphorus through pods and hay.

Nitrogen concentration in pods was increased by phosphorus application and it was found that at harvest its concentration was more in seeds than in hay. Application of phosphorus with nitrogen and potash increased phosphorus content in plant. Highest phosphorus concentration was observed in seeds followed by leaves and shoots. It was also noticed that application of phosphorus with potassium increased potassium concentration and the highest concentration was found in hay followed by seeds (Puntamkar and Bathkal, 1967).

Omueti and Oyenuga (1970) observed that phosphorus fertilization did not significantly affect the yields of groundnut, but it increased the phosphorus, potassium, calcium, zinc, cobalt and molybdenum contents of seeds. Trials with nitrogen and phosphorus showed that increase in the rate of nitrogen and phosphorus applications increased the nitrogen content in groundnut plant (Bhan and Misra, 1970). Palaniappan (1970) observed that phosphorus application decreased potassium content of haulm and significantly decreased potassium uptake.

Uptake of nitrogen was found to be progressively increased by phosphorus fertilization. Yadav and Singh (1970) reported that the content of phosphorus and potassium increased with higher levels of phosphorus application. Phosphate manuring of groundnut helped in the utilization of non-exchangeable potassium from the soil to a limited extent (Roy and Chatterjee, 1972). Bhan (1977) reported that the combined application of nitrogen and phosphorus increased the nitrogen and phosphorus concentration of plants and their total uptake.

Contrary to the above findings, Walker (1975) reported that percentage nitrogen contents of leaves, stems, roots, hulls and seeds of spanish and runner groundnuts were unaffected by rates of phosphorus. Potassium content was unaffected by applied nitrogen and phosphorus, but increasing levels of potassium increased potassium concentration. He also found that calcium levels of stems and roots generally increased with increase in applied phosphorus. It was also reported that phosphorus had no significant effect on the phosphorus content of the healthy mature seeds (Walker et al., 1974).

6. Effect of potassium on growth characters.

Middleton et al. (1945) reported that the increased yields due to potassium nutrition was through its effect on plant size and not by kernel development. A pronounced vegetative growth by potassium fertilization was observed by Brady and Colwell (1945). Harris (1949) noticed that deficiency of potassium significantly reduced top growth. However, the deficiency due to potassium developed less readily in groundnut than in most crops and the growth was found to improve by increased availability of potassium (Hong and Schuylenborgh, 1953). Studies on the effect of nitrogen, phosphorus and potassium singly and in combination showed that growth of groundnut plants were increased by phosphorus and potassium levels (Singh and Pathak, 1969). Walker (1973) observed that potassium increased leaf weight but it did not affect the weight of other parts.

On the other hand, Puntamkar and Bathkal (1967) found that potassium had no significant effect on the number of branches per plant. Son et al. (1974) reported that higher levels of calcium and potassium application decreased the vegetative growth of above ground parts in groundnut.

7. Effect of potassium on nodulation and nitrogen fixation.

Veeraraghavan (1964) found that different levels of potassium gave an increasing trend in the mean number of nodules per plant though the difference was not significant. Sreedharan and George (1968) observed that lime, potassium and magnesium significantly increased nodulation in groundnut.

Nair *et al.* (1970) reported that the number of nodules produced per plant was significantly reduced due to lack of potassium at all stages of the crop. Significant correlation was noticed between nodular tissue weight and available potassium indicating that potassium influences crop growth indirectly through increased nodulation (Nair *et al.*, 1971). Muthuswamy (1973) reported that phosphorus at the rate of 30 kg P_2O_5 per hectare and potassium at the rate of 90 kg K_2O per hectare significantly increased the nodule numbers whereas, nitrogen at different levels gave a reduced nodular count.

8. Effect of potassium on yield and yield attributes.

Harris (1949) found that deficiency of potassium significantly reduced yields of unshelled nuts. It was also reported that the mean number of mature pods was significantly reduced when the plant was grown in nutrient solution deficient in potassium (Bledsoe and Harris, 1950). Hong and Schuylenborgh (1953) observed that yield and ripening were improved by increased availability of potassium. Application of potassium chloride at the rate of 224 kg per hectare could result in an increase in groundnut hay yield upto 30 per cent with a simultaneous depression in nut yield by 14 per cent (Comber, 1959). Panikkar (1961) reported that the demand of groundnut for soil potassium was large and an average response of 4.6 kg nuts per one kg of potassium was obtained in 15 trials at Akola. Seshadri (1962) reviewing experiments in Tamilnadu reported that potassium at the rate of 56 kg and 84 kg K_2O per hectare over a basal dressing of cattle manure gave the best results in groundnut yields under rainfed and irrigated conditions respectively.

An experiment conducted in the red loam soils of Kerala showed that the weight of pods per plant and the yield of pods per hectare were significantly increased with higher levels of potassium (Veeraraghavan, 1964). Similarly Banerjee et al. (1967) observed that high yields were associated with higher levels of potassium. Bodade and Rao (1967) concluded that 45 kg K_2O per hectare gave 2.24 times more yield than that of control. Application of potassium at 25 kg and 50 kg K_2O per hectare significantly increased the pod yield of groundnut by 24 per cent and 38 per cent respectively, over control (Sreedharan and George, 1968). They also noted that potassium increased yield of haulm and improved the shelling percentage of groundnut. Experiments conducted in brown sandy soils of Guyana showed that potassium application at 149 kg K per hectare gave significant increase in yield as compared to 84 kg K per hectare (Chesney and Diyaljee, 1969).

Herrera *et al.* (1969) reported significant yield increases for levels upto 100 kg K_2O per hectare. Increase in fruiting by application of potassium was noticed by Singh and Pathak (1969) in an experiment conducted at Thabua. They also found that potassium at the rate of 22.5 kg K_2O per hectare gave an yield increase of 34 per cent over control. After reviewing the results of trials conducted under different soil types, Prasad and Mahapatra (1970) concluded that groundnut gave good response to potassium fertilization. They found that red soils responded only for higher levels of potassium such as 60 kg K_2O per hectare. Raheja *et al.* (1970) observed that 50 kg and 60 kg K_2O per hectare gave significantly higher yields than lower levels in rainfed and irrigated conditions respectively. Application of potassium chloride at the rate of 30, 60 and 90 kg per hectare was found to increase yield by 430, 680 and 760 kg pods per hectare respectively and the percentage of one seeded pods was decreased by this nutrient (Gillier and Gautreau, 1971).

Habeebulla (1973) observed that pod and haulm yields were influenced by potassium application. Results of All India Co-ordinated Agronomic Experiments showed that groundnut responded significantly well to potassium fertilization (Mahapatra *et al*., 1973). Jayachandran *et al*. (1973) observed a consistantly significant increase in yield of pods during all the four years of studies due to higher levels of potassium chloride. Walker *et al*. (1974) observed that peanut yields were significantly increased by potassium top dressing. Significant yield increases for potassium levels upto 100 kg K_2O per hectare were reported by Hickey *et al*. (1974).

Gopalasamy *et al*. (1976) observed that pod yield increases were significant upto 90 kg K_2O per hectare and economic dose for irrigated bunch type of groundnut was 75 kg K_2O per hectare. Increases in yield by higher levels of potassium were also reported by Badanur *et al*. (1976), Natarajan *et al*. (1976) and Gopalasamy *et al*.(1977). Boominathan *et al*. (1977) reported that variety TMV-2 gave the highest shelling percentage of 82 by the application of 20 kg N, 40 kg P_2O_5 and 60 kg K_2O per hectare. In solution culture trials, Gopalakrishnan *et al*. (1977) observed that nutrient solution deficient in K+Mg and K+Mg+Ca produced a reduction in yield of unshelled nuts by 84.7 per cent and 86.1 per cent respectively, compared to yield produced in complete nutrient solutions. Reddy *et al*. (1977) observed that potassium levels upto 80 kg K_2O per hectare significantly increased the yield of pods.

They also found that the yield maximisation level was 100.2 kg K_2O per hectare, whereas the profit maximisation level was 70.7 kg K_2O per hectare.

Contrary to the above results, Tella et al. (1970) observed that potassium decreased yields in experiments on podzolized soils of Sao Paulo. Trials with two varieties of groundnut showed that potassium depressed yields on both when applied without phosphorus (Anderson, 1970). Similarly Hall (1975) reported that potassium chloride decreased the yields when applied together with phosphorus and calcium. Fertilizer studies on the brown sands of Guyana showed that potassium levels at the rate of 122 kg, 144 kg and 166 kg K per hectare did not produce any significant difference in yield (Chesney, 1975).

9. Effect of potassium on quality of kernels.

(a) Affect on protein content

Brady and Colwell (1945) reported that yield increases were obtained by potassium application but without corresponding increase in quality. On the other hand, the importance of potassium nutrition for the synthesis of proteins is emphasised by Kirklawton and Cook (1954) and Tisdale and Nelson (1975). Bhuiya and Chawdury (1974) observed that potassium application decreased the protein content of groundnut kernels.

(b) Effect of potassium on oil content

Hong and Schuylenborgh (1953) observed that oil content of seeds was increased by potassium application. Similar results were also reported by Veeraraghavan (1964) and Nakagava et al. (1966). Roy and Chatterjee (1972) observed that potassium manuring increased oil content in groundnut. Habeebulla (1973) also found similar results. It was found that phosphorus and potassium increased the percentage of oil in kernels and the response was found greater for applied potassium than for applied phosphorus (Bhuiya and Chawdhury, 1974). Gupta et al. (1975) reported that potassium application enhanced oil content by activating fat producing enzymes.

On the other hand, Puntamkar and Bathkal (1967) found that potassium significantly decreased the oil content of kernels. Application of nitrogen and potassium without phosphorus and sulphur decreased the oil content in trials conducted in black cotton soils of Indore (Yadav and Singh, 1970). Son et al. (1974) reported that oil content in groundnut kernel was unaffected by application of calcium and potassium.

10. Effect of potassium on the chemical composition and uptake of nutrients.

Bouger (1949) reported that a crop producing 1681 kg pods per hectare required 41.47 kg K_2O. Significant reductions in the potassium content of plants grown under potassium deficient nutrient solution was observed by Bledsoe and Harris (1950). A review of mineral nutrition of groundnut in relation to its growth, yield and quality shows that the average amount of potassium removed in Mauritius was 109.36 kg K_2O per hectare and that in Egypt was 38.52 kg K_2O per hectare (Verma and Bajpai, 1964).

In groundnut, higher quantities of potassium, calcium and magnesium were present in the forage, while nitrogen and phosphorus were more in pods (Gillier, 1966). Increases of nitrogen content in leaves with simultaneous decreases in kernels by higher levels of potassium were reported by Nakagava et al. (1966). They further reported that potassium application increased phosphorus and potassium levels of leaves. Puntamkar and Bathkal (1967) observed that application of potassium decreased the nitrogen concentration in pods but it was increased in hay. At harvest, nitrogen concentration was more in seeds than in hay. They further observed that application of potassium alone and in combination with phosphorus increased potassium concentration in plants. The highest concentration was found in hay followed by seed. They found that potassium application increased the total uptake of of phosphorus through pods and hay. Application of potassium alone or in combination with phosphorus had increased the total uptake of potassium.

The P and K content in plants increased with the increases in the levels of these nutrients (Nicholaides and Cox, 1970). Yadav and Singh (1970) observed that the content of phosphorus and potassium increased with higher levels of potassium application in groundnut. Application of potassium slightly increased leaf potassium levels and reduced leaf phosphorus levels to near optimum level (Gillier and Gautreau, 1971). It was reported that potassium manuring showed unused residues of available potassium in groundnut plant (Roy and Chatterjee, 1972). Increasing levels of potassium increased potassium content in leaves, stems and roots but not in seeds and hulls. Leaves and stems contained highest potassium levels followed by roots, seeds and hulls (Walker et al., 1974). Habeebulla (1973) observed that the application of potassium was found to increase the nitrogen content of haulm; the phosphorus content was also increased to a smaller extent. He also found that potassium content of haulm was increased by all levels of potassium and that of the kernel was increased by the highest dose of potassium. The adequate level of potassium in the tops of peanut plant was reported as 3.4 to 3.8 per cent by Fageria (1976).

Balasundaram et al. (1976) observed that higher levels of potassium resulted in an enhanced uptake of potassium causing a concomitant reduction in the uptake of nitrogen. Loganathan and Krishnamurthy (1977) observed that at harvest stage, major portion of absorbed potassium was accumulated in the stems and leaves.

However, it is also reported that application of potassium did not affect the percentage of nitrogen content of leaves, stems, roots, hulls and seeds of groundnut. Similarly phosphorus and potassium had no significant effect on the phosphorus content of the healthy seeds (Walker et al., 1974).

11. Performances of TMV-2 and TMV-9 in the production of pods and quality of kernels.

Mohammed et al. (1973 a) observed in comparative yield trials conducted in Tamilnadu that TMV-9 gave a mean yield increase of 61.9 per cent over TMV-2. They also found that TMV-9 possessed a seed dormancy of 96 per cent upto 20 days after maturity, whereas, TMV-2 did not have seed dormancy. This seed dormancy is a highly desirable quality of TMV-9 over TMV-2 since this can overcome the possibility of loss due to sprouting of pods in the field. The shelling outturn of TMV-9 (75.6 per cent) was slightly less than that of TMV-2. They further observed that kernels of TMV-9 yielded 51.4 per cent oil with an increase of 3 per cent over TMV-2. In scattered block trials at 10 centres in Tamilnadu, the variety TMV-9 produced 20.4 per cent more yield of pods over that produced by TMV-2.

It was also reported (Anon, 1974) that varieties TMV-2 and TMV-9 matured in 105 days and possessed an oil content of 49 per cent and 51.4 per cent, respectively. The 1000 kernel weights of TMV-2 and TMV-9 were 330 g and 310 g, respectively. So also the number of pods per plant of TMV-2 and TMV-9 were 12 and 20 respectively.

Purushothaman et al. (1974) in a comparative yield trial of groundnut varieties at Coimbatore found that TMV-2 and TMV-9 under a fertilizer application of 10 kg N, 22 kg P_2O_5 and 32 kg K_2O produced 480 kg and 770 kg pods per hectare, respectively. Further, they observed that the shelling percentage of TMV-2 and TMV-9 were 75 per cent and 74.6 per cent, respectively. In this experiment it was noticed that TMV-2 matured in 105 days, whereas, TMV-9 required 110 days to attain maturity. In another comparative yield trial at Kovilpatti, the variety TMV-2 recorded the highest shelling percentage of 82 (Soominathan et al., 1977).

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation was undertaken to study the performance of two improved varieties of groundnut (TMV-2 and TMV-9) with graded doses of phosphorus and potassium, under the agroclimatic conditions of Vellayani.

Materials

I. Experimental site.

The experiment was laid out in the red loam soils of the Instructional Farm, Vellayani. The nutrient status of the soil before starting of the experiment are furnished in Appendix I. A bulk crop of tapioca was raised in the field from October 1975 to August 1976, after which the field remained fallow for three months before the starting of the experiment.

II. Season.

The experiment was conducted between December 1976 and March 1977. The weather data recorded during the above period are given in Appendix II and Fig.1. The deviations of the weather data from the average weather conditions for the last five years are also presented. Though, the crop was sown on 1-12-1976 the weather data of two weeks preceeding the cropping period are also presented to show

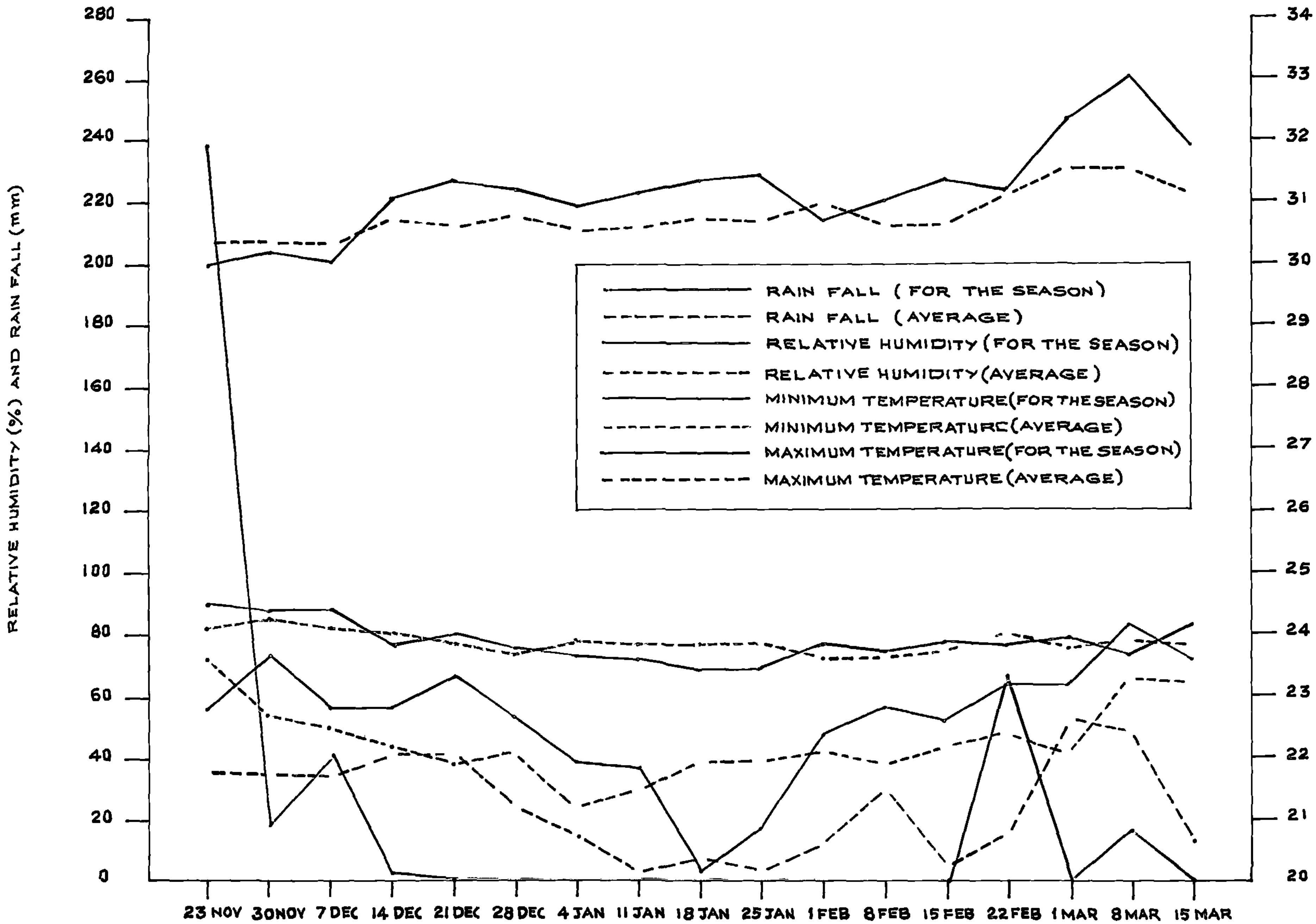


FIG 1 WEATHER CONDITIONS DURING THE CROP SEASON 17th NOVEMBER 1976 TO 15th MARCH 1977 AND AVERAGE WEATHER CONDITIONS (1971-72 TO 1975-76)

the moisture condition of the soil at the time of sowing. The total deviation in the rainfall of the crop season from the average for five years (-208.5 mm) shows that it was a comparatively drier period. The adverse effect of this was overcome by providing irrigation.

III. Varieties.

1. TMV-2

This is a bunch variety with no seed dormancy and matures in about 105 days. The pods are small and one to two seeded. It is suited for both rainfed and irrigated conditions. This variety is popular among groundnut growers in Kerala. The kernels of this variety have an oil content of 49%.

2. TMV-9

It is a high yielding bunch variety having seed dormancy and maturing in 105 to 110 days. It is suitable for both rainfed and irrigated conditions. The main stem is erect, medium tall, light purple, hairy, with non-branching primary branches. The pods are small in size and one to two seeded. The kernels have an oil content of 51.4%.

IV. Seed materials.

The seeds of varieties TMV-2 and TMV-9 were obtained from the Regional Oilseeds Experiment Station, Tindivanam, Tamilnadu. The germination of TMV-2 and TMV-9 were tested and found to be 99% and 97% respectively.

V. Manures and fertilizers.

A uniform basal dressing of cattle manure at the rate of 10 metric tonnes per hectare was given to all the plots. Ammonium sulphate, superphosphate and muriate of potash were used as sources of N, P and K respectively. A uniform dose of nitrogen at the rate of 10 kg/ha was given as basal dressing. Phosphorus and potassium were applied as basal dressing in accordance with the treatments. Lime at the rate of 1 t/ha was applied at the time of flowering and mixed with the soil by light hoeing as per package of practices recommendations of the Kerala Agricultural University (Anon. 1976).

Ammonium sulphate analysing 20.3 per cent N, superphosphate analysing 16 per cent P_2O_5, muriate of potash analysing 59.6 per cent K_2O and cattle manure (dry basis) analysing 0.47 per cent N, 0.26 per cent P and 0.32 per cent K were used.

Methods

I. Layout and Design.

The trial was laid out in a 2 x 3^2 factorial experiment with 2 varieties and 3 levels each of P_2O_5 and

K_2O, partially confounding PK in replication I and PK^2 in replication II.

Replications: 2

II. Treatments.

a. Levels of phosphorus

1. p_0 50 kg P_2O_5/ha
2. p_1 75 kg P_2O_5/ha
3. p_2 100 kg P_2O_5/ha

b. Levels of potassium

1. k_0 25 kg K_2O/ha
2. k_1 50 kg K_2O/ha
3. k_2 75 kg K_2O/ha

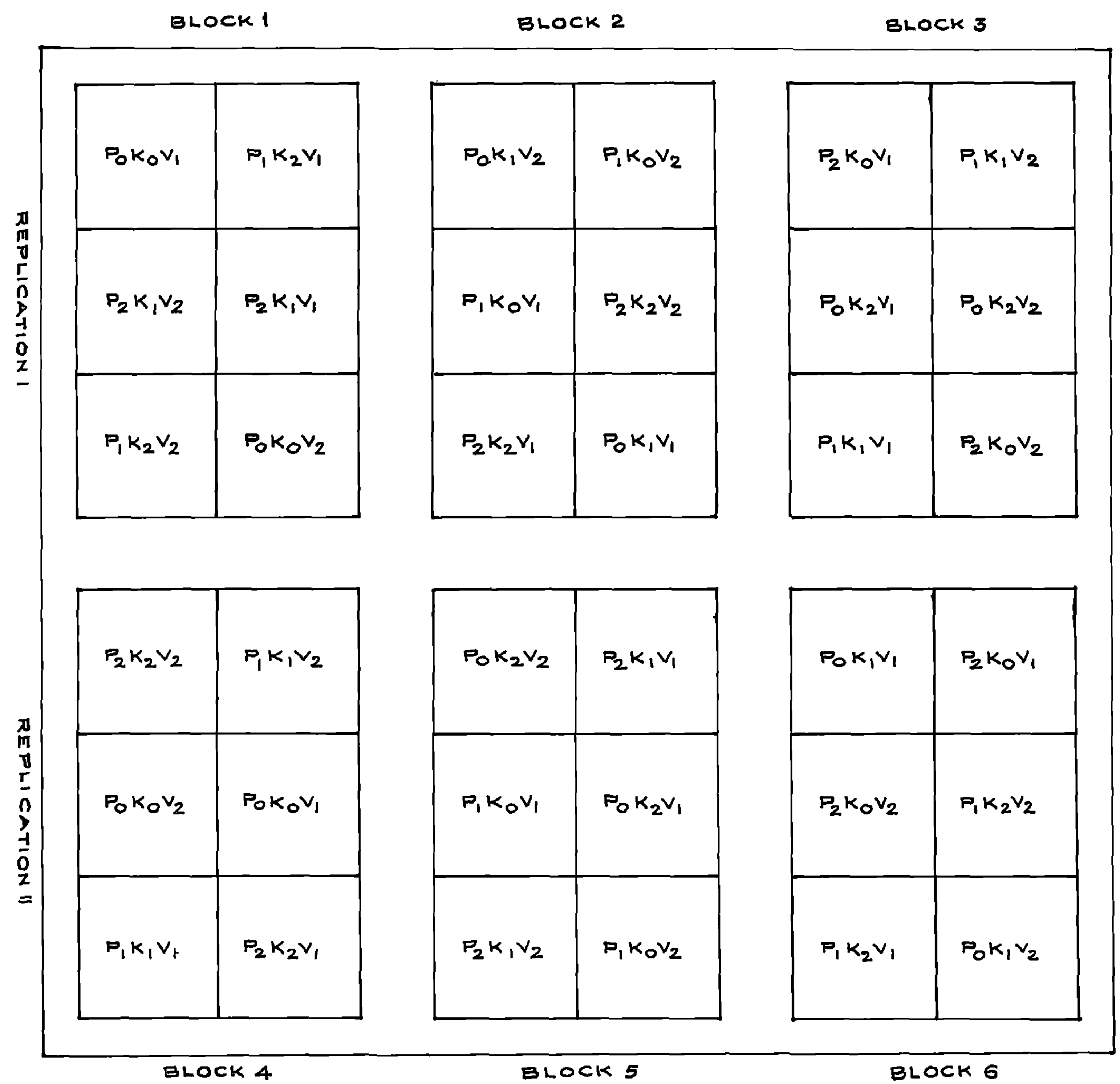
c. Varieties

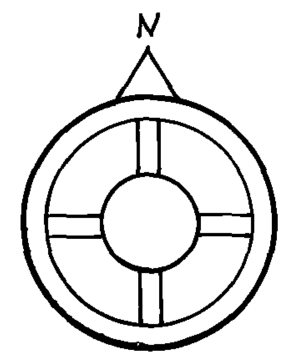
1. v_1 TMV-2
2. v_2 TMV-9

d. Treatment combinations

1. $p_0 k_0 v_1$	7. $p_1 k_0 v_1$	13. $p_2k_0v_1$
2. $p_0 k_0 v_2$	8. $p_1 k_0 v_2$	14. $p_2 k_0 v_2$
3. $p_0 k_1 v_1$	9. $p_1 k_1 v_1$	15. $p_2 k_1 v_1$
4. $p_0 k_1 v_2$	10. $p_1 k_1 v_2$	16. $p_2 k_1 v_2$
5. $p_0 k_2 v_1$	11. $p_1 k_2 v_1$	17. $p_2 k_2 v_1$
6. $p_0 k_2 v_2$	12. $p_1 k_2 v_2$	18. $p_2 k_2 v_2$

FIG 2 LAY OUT PLAN





2 X 3 X 3 FACTORIAL EXPERIMENT PARTIALLY CONFOUNDING PK IN REPLICATION I AND PK^2 IN REPLICATION II

REPLICATIONS - 2

TREATMENTS PHOSPHORUS	POTASSIUM
P_0 50 kg P_2O_5/ha	K_0 25 kg K_2O/ha
P_1 75 kg P_2O_5/ha	K_1 50 kg K_2O/ha
P_2 100 kg P_2O_5/ha	K_2 75 kg K_2O/ha

VARIETY

V_1 TMV - 2

V_2 TMV - 9

GROSS PLOT SIZE 5 4 X 5 1 M

NET PLOT SIZE 4 95 X 4 8 M

III. Size of plots.

Gross plot size - 5.4 m x 5.1 m

Net plot size - 4.95 m x 4.8 m

Net area of a plot - 23.76 m^2

IV. Spacing.

22.5 cm x 15 cm

V. Plant population.

Number of plants per gross plot - 816

Number of plants per net plot - 704

VI. Field culture.

1. Preparatory cultivation

The experimental site was ploughed once with tractor on 6-11-1976. With the receipt of sufficient showers, the tillage operations were resumed and weeds and stubbles were removed. The field was then laid in to blocks and plots as per experimental design. The plots were dug thoroughly to obtain a fine tilth and then levelled.

2. Manuring

The entire quantity of the manures and fertilizers, except lime, were given as basal dressing and thoroughly mixed with the soil. Lime was applied at the time of second weeding.

3. Seeds and sowing

The seeds were treated with ceresan 1% dust on 30-11-76 and were inoculated with Rhizobium culture eight hours after the fungicide treatment. The sowing was done on 1-12-1976. Germination was noticed on the third day. Gap filling was done on the seventh day to secure a perfect and uniform stand of the crop.

4. After cultivation

The first round of intercultivation was carried out on 20-12-1976 for weed control. The second round of inter-cultivation was given to the crop on 9-1-1977 for loosening the top soil, followed by hand weeding and earthing up.

5. Irrigation

The crop was given weekly irrigations from the second week after sowing, except during the 12th week when there was sufficient rainfall.

6. Plant protection

There were no serious attack of any pests or diseases during the cropping period except the appearance of tikka leaf spots at the time of harvest. Prophylatic sprayings with fungicides and insecticides were given whenever necessary.

7. Harvesting

The crop started yellowing after 100 days and was harvested on 14-3-1977. To facilitate easy uprooting the plots were given a flood irrigation the previous day.

The observation plants were removed first. Two boarder rows were harvested and separated. The remaining plants of the plot were hand pulled plotwise and removed to threshing yard. The pods were hand picked and the weight of pods and haulms recorded. The pods were then sun-dried and the weight recorded.

Observations Recorded

The characters studied and analysis carried out are as follows:

A. Biometric observations.

1. Height of plants

Ten plants from each plots were selected at random and tagged. The height of central shoot from the hypocotyle to the terminal bud was measured in centimetres and the average height per plant was worked out and recorded.

2. Number of branches per plant

The number of primary branches seen on each of the ten observation plants were counted and the average number per plant was worked out and recorded.

3. Number of leaves per plant

The number of leaves of the observation plants were recorded and the average number of leaves per plant was then worked out and recorded.

4. Average weight of root nodules per plant

This observation was recorded three times, the first at 30 days after sowing, the second at 60 days after sowing and the third 90 days after sowing. Five plants were selected at random from the inside boarder rows of each plot. The plants were dug out at a uniform depth of approximately 40 cm. The roots of the plants were washed and cleaned with the help of a soft hair brush to remove soil particles. The nodules were carefully removed from the roots and oven dried. The weight of the nodules per plant was then worked out and recorded.

5. Number of days taken for flowering

The number of days taken for flowerng was recorded for all the observation plants and the average number of days taken for flowering was then calculated and recorded.

6. Number of pegs formed per plant

The total number of pegs formed in the observation plants were counted and the number of pegs formed per plant was then calculated and recorded.

7. Number of mature pods per plant

The number of mature pods seen on the observation plants at the time of harvest were counted and the average number of pods per plant was recorded.

8. Percentage of pegs developed in to mature pods

From the data of total number of pegs formed and the total number of pods developed per plant the percentage of pegs to mature pods was worked out.

9. Average weight of mature pods per plant

The mature pods were removed from the observation plants and oven-dried at 70°C for 15 to 18 hours until constant weight was attained. The dry weight of pods per plant was then worked out.

10. Yield of pods per hectare

Weight of pods per plot was recorded after completion of plucking. Samples of approximately one kg were drawn from each plot and accurately weighed. These samples were labelled and dried in sun for five days. Drying was continued till constant weight was obtained. The actual yield per plot was worked out on the basis of the dry weight and the yield of pods per hectare was then calculated and recorded.

11. Yield of haulm

The total weight of the haulm obtained from each plot after separation of pods was recorded. The yield of haulm per hectare was calculated from this data.

12. Percentage of two seeded pods

A random sample of pods was taken from each plot. Single seeded and two seeded pods were separetely counted and the percentage of two seeded pods were calculated.

13. Natural test weight of pods

One litre of pods was measured from the pods obtained from each plot and their weight recorded.

14. Weight of 100 pods

Samples of 100 two seeded pods were randomly drawn from each plot and their weights were recorded.

15. Weight of 100 kernels

This was obtained by weighing 100 randomly separated kernels from each plot.

16. Shelling percentage

One hundred gram of pods were randomly drawn from each plot decorticated and the weights of kernels were recorded and expressed as percentage.

B. Chemical Analysis.

1. Nitrogen content of haulm

The percentage of nitrogen in haulm on dry weight basis was estimated by micro-kjeldahl method (Jackson, 1967).

2. Nitrogen content of kernels

The kernel samples were analysed for their nitrogen content by micro-kjeldahl's method.

3. Nitrogen content of shell

The shell samples were analysed for their nitrogen content by micro-kjeldahl's method.

4. Total uptake of nitrogen by plants

From the nitrogen content of haulm, kernel and shell the total uptake of nitrogen was then worked out.

5. Phosphorus content of plants

The plant samples were analysed for their phosphorus contents by colorimetric method and recorded in percentage.

6. Phosphorus content of kernel

The samples of kernel from the observation plants were analysed for their phosphorus content by colorimetric method and the percentage of phosphorus was recorded.

7. Phosphorus content of shell

The shell samples were analysed for their phosphorus content and recorded in percentage.

8. Total uptake of phosphorus by plants

The total uptake of phosphorus was worked out from the phosphorus content of haulm, kernel and shell and recorded as kg of P_2O_5 per hectare.

9. Potassium content of haulm

The plant samples were analysed for their potassium contents by flame photometer method and expressed in percentage.

10. Potassium content of kernel

The percentages of potassium in kernel samples were analysed by flame photometer and recorded.

11. Potassium content of shell

The shell samples were analysed for their potassium content by flame photometer and recorded.

12. Total uptake of potassium by plants

From the percentage of potassium in the haulm, kernel and shell the total uptake of potassium by the plants were then worked out in kg K_2O per hectare.

13. Protein content of kernel

From the nitrogen content of kernel samples the protein content was then worked out and recorded.

14. Oil content of kernel

The oil content of kernel of each sample was then estimated gravimetrically by cold percolation method (Kartha and Sethi, 1957).

C. Statistical Analysis.

Data relating to different observations were analysed statistically following the methods of Federer (1963). The data on the percentage of pegs developed into mature pods and the percentage of two seeded pods were analysed after angular transformation. Important correlations, response functions and economics of manuring were worked out.

RESULTS

RESULTS

The data relating to various biometric observations and chemical analysis were statistically analysed and the results are presented below.

A. Growth Characters

1. Height of plants at maturity.

The data on height of plants at maturity have been analysed and the analysis of variance table is given in Appendix III. The mean heights of plants at maturity are presented in Table 1.

The mean values show that the phosphorus levels of 75 kg and 100 kg P_2O_5 per hectare increased the height of plants with respect to the lowest level. There was a difference of 5.7 cm in the height of plants between the highest and lowest levels of P_2O_5.

Potassium also increased the height of plants significantly, eventhough the difference between the higher levels of 50 kg and 75 kg K_2O per hectare was not significant.

The difference in height between the varieties was not significant. But the mean height of TMV-9 was 1.06 cm more than that of TMV-2.

Table 1. Mean height of groundnut plant at maturity (cm)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	25.23	26.57	25.90
	75	29.05	29.90	29.48
	100	31.10	32.10	31.60
K_2O kg/ha	25	25.77	27.28	26.53
	50	29.55	29.55	29.55
	75	30.07	31.73	30.99
Mean		28.46	29.52	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	23.18	26.05	30.35	26.53
	50	26.08	30.60	31.98	29.55
	75	28.45	31.78	32.48	30.99
Mean		25.90	29.48	31.60	

C.D.(0.05) for levels of P or K = 1.45
C.D.(0.05) for variety = 1.19
C.D.(0.05) for combination of P and K = 2.51
C.D.(0.05) for combinations of V and P or V and K = 2.05

2. Number of branches per plant.

The number of primary branches recorded at maturity has been analysed and the analysis of variance is given in Appendix IV. The mean values are presented in Table 2.

The results show that none of the treatments had any significant influence on branching.

3. Number of leaves per plant.

The number of leaves per plant at maturity has been statistically analysed and the analysis of variance is given in Appendix V. The mean number of leaves per plant is presented in Table 3.

It shows that phosphorus and potassium progressively increased the number of leaves per plant. But significant difference in the number of leaves was found only between the highest and lowest levels of P_2O_5.

Potassium levels of 50 kg and 75 kg K_2O per hectare significantly increased the number of leaves per plant over 25 kg K_2O per hectare. Here, the difference between the higher levels was not significant.

The varieties did not show any significant difference with respect to this character.

4. Weight of root nodules per plant.

The weights of root nodules per plant taken during three stages, first on the 30th day, the second the 60th day and the third on the 90th day after sowing, have been

Table 2. Mean number of branches per groundnut plant

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	4.75	5.68	5.22
	75	5.13	5.67	5.40
	100	5.17	4.92	5.05
K_2O kg/ha	25	4.68	5.07	4.88
	50	5.18	5.52	5.35
	75	5.18	5.68	5.43
	Mean	5.02	5.42	N.S.

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	4.75	5.20	4.68	4.88
	50	5.25	5.38	5.43	5.35
	75	5.65	5.63	5.03	5.43
	Mean	5.22	5.40	5.05	N.S.

N.S. - Not significant

Table 3. Mean number of leaves per groundnut plant

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	55.83	59.50	57.67
	75	62.33	61.17	61.75
	100	65.50	65.17	65.34
K_2O kg/ha	25	56.83	56.50	56.67
	50	61.83	63.83	62.83
	75	65.00	65.50	65.25
	Mean	61.22	61.95	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	52.75	57.75	59.50	56.67
	50	58.50	61.75	68.25	62.83
	75	61.75	65.75	68.25	65.25
	Mean	57.67	61.75	65.34	

C.D.(0.05) for levels of P or K = 4.10
C.D.(0.05) for variety = 3.35
C.D.(0.05) for combination of P and K = 7.10

separately analysed and the analysis of variance are furnished in Appendices VI, VII and VIII. The corresponding mean values are presented in Tables 4, 5 and 6. It is seen from the results that the effect of phosphorus alone on the weight of root nodules per plant was significant at all the stages. The highest level of 100 kg P_2O_5 per hectare significantly increased the weight of root nodules over 75 kg and 50 kg on the first and last observations. At 60th day after sowing the weight of root nodules by the level of 100 kg P_2O_5 per hectare was significantly increased over that of 50 kg P_2O_5 per hectare.

The effect of increased levels of potassium on nodule weight was not significant during all the stages. Similarly there was no significant difference in the weight of nodules between the two varieties in any of the three stages of observation.

5. Number of days taken for flowering.

The data on the number of days taken for first flowering have been analysed and the analysis of variance is given in Appendix IX. The mean values are presented in Table 7.

The results show that all the treatments have influenced the time taken for flowering. As the phosphorus levels were increased from 50 to 100 kg P_2O_5 per hectare

Table 4. Mean weight of nodular tissue per groundnut plant (mg) (1st stage - 30th day after sowing)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	23.33	25.33	24.33
	75	24.17	24.83	24.50
	100	28.00	26.17	27.09
K_2O kg/ha	25	24.00	26.00	25.00
	50	24.33	24.00	24.17
	75	27.17	26.33	26.75
	Mean	25.17	25.44	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	21.25	25.00	28.75	25.00
	50	23.50	23.50	25.50	24.17
	75	28.25	25.00	27.00	26.85
	Mean	24.33	24.50	27.09	

C.D.(0.05) for levels of P or K = 2.37

Table 5. Mean weight of nodular tissue per groundnut plant (mg) (2nd stage - 60th day after sowing)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	41.83	43.17	42.50
	75	44.67	47.17	45.92
	100	51.17	50.83	51.00
K_2O kg/ha	25	45.50	46.50	46.00
	50	45.50	45.33	45.42
	75	46.67	49.33	48.00
	Mean	45.89	47.06	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	40.75	45.00	52.25	46.00
	50	42.50	44.50	49.25	45.42
	75	44.25	43.25	51.50	48.00
	Mean	42.50	45.92	51.00	

C.D.(0.05) for levels of P or K = 5.51

Table 6. Mean weight of nodular tissue per groundnut plant (mg) (3rd stage - 90th day after sowing)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	49.00	49.33	49.17
	75	51.33	51.50	51.42
	100	53.83	54.50	54.17
K_2O kg/ha	25	50.33	50.67	50.50
	50	51.83	52.67	52.25
	75	52.00	52.00	52.00
	Mean	51.39	51.78	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	46.25	51.75	53.50	50.50
	50	50.50	51.50	54.75	52.25
	75	50.75	51.00	54.25	52.00
	Mean	49.17	51.42	54.17	

C.D.(0.05) for levels of P or K = 2.16

there were significant reduction in the number of days taken for first flowering.

Similarly potassium levels also significantly decreased the time taken for flowering, and the minimum number of days taken was for 75 kg K_2O per hectare. The combination of 100 kg P_2O_5 and 75 kg K_2O (P_2K_2) significantly reduced the number of days taken for flowering to the minimum, while the combination of 50 kg P_2O_5 and 25 kg K_2O (P_0K_0) has taken the maximum number of days.

The number of days taken for flowering by TMV-9 was significantly higher than that by TMV-2.

B. Yield and Yield Attributes

1. Number of pegs formed per plant.

The data on the total number of pegs formed per plant have been analysed and the analysis of variance is presented in Appendix X. The mean values are furnished in Table 8.

The results show that the levels of phosphorus and potassium as well as varieties have significantly influenced the formation of pegs. Higher levels of phosphorus increased the number of pegs formed per plant over the respective lower levels. At 100 kg P_2O_5 the pegs produced per plant was maximum (24.10).

Similarly higher levels of potassium increased the

Table 7. Mean number of days taken for flowering of groundnut

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	23.13	24.25	23.69
	75	22.52	23.65	23.09
	100	22.13	23.06	22.58
K_2O kg/ha	25	23.03	23.85	23.44
	50	22.52	23.57	23.05
	75	22.23	23.52	22.88
	Mean	22.59	23.65	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	24.25	23.43	22.65	23.44
	50	23.60	22.93	22.60	23.05
	75	23.23	22.90	22.50	22.88
	Mean	23.69	23.09	22.58	

C.D.(0.05) for levels of P or K = 0.15
C.D.(0.05) for variety = 0.12
C.D.(0.05) for combinations of V and P or V and K = 0.21
C.D.(0.05) for combinations of P and K = 0.26

Table 8. Mean number of pegs formed per groundnut plant

		TMV-2	TMV-9	Mean
P_2O_5	50	11.77	13.42	12.60
	75	16.65	19.87	18.26
	100	22.22	25.97	24.10
K_2O kg/ha	25	14.27	16.80	15.54
	50	17.25	20.25	18.75
	75	19.12	22.20	20.66
	Mean	16.88	19.75	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	10.40	15.20	21.00	15.54
	50	12.48	19.33	24.45	18.75
	75	14.90	20.25	26.83	20.66
	Mean	12.60	18.26	24.10	

C.D.(0.05) for levels of P or K = 1.04
C.D.(0.05) for variety = 0.84
C.D.(0.05) for combination of P and K = 1.78
C.D.(0.05) for combinations of V and P or V and K = 1.45

number of pegs formed per plant and the differences between the levels 25 kg, 50 kg and 75 kg K_2O per hectare were significant.

The number of pegs produced by the variety TMV-9 was significantly higher than that by TMV-2.

2. Number of mature pods per plant.

The data on the number of mature pods per plant at harvest were analysed and the analysis of variance table is given in Appendix XI. The mean number of pods per plant is furnished in Table 9.

It is seen from the results that higher levels of 75 kg and 100 kg P_2O_5 per hectare gave significant increase in the number of pods per plant over the level of 50 kg P_2O_5 per hectare. But there was no significant difference between the higher levels.

Potassium levels of 50 kg and 75 kg K_2O per hectare also significantly increased the number of pods per plant and the maximum number (7.91) was produced by the level of 75 kg K_2O per hectare.

TMV-9 produced a higher number of pods (7.83 pods per plant) than that of TMV-2 (7.03).

3. Percentage of pegs developed to mature pods.

The data on percentage of pegs developed to mature pods were analysed after angular transformation and the

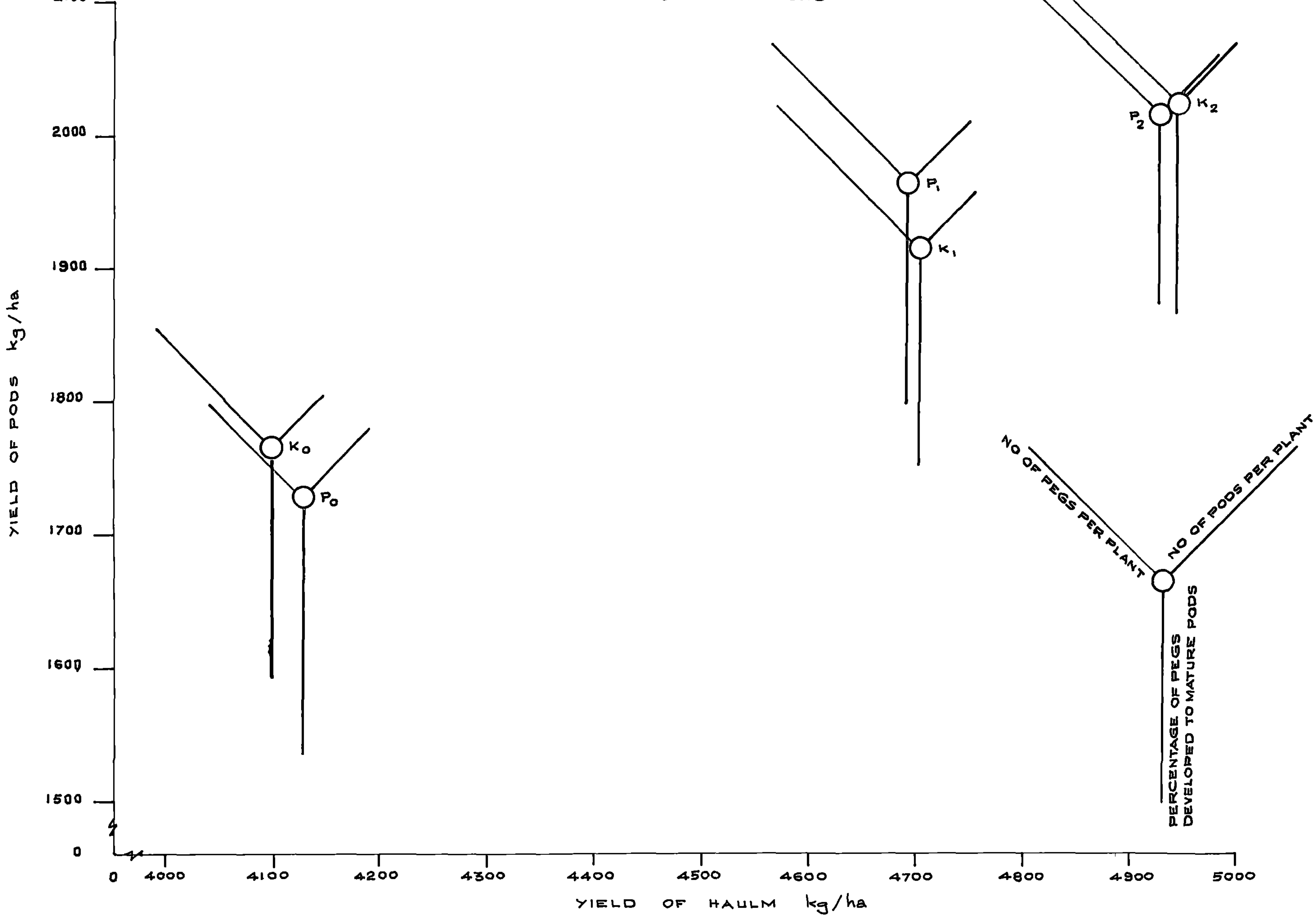
Table 9. Mean number of mature pods per groundnut plant

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	6.48	7.23	6.86
	75	7.33	8.12	7.73
	100	7.43	8.15	7.79
K_2O kg/ha	25	6.62	7.40	7.01
	50	7.18	7.73	7.46
	75	7.45	8.37	7.91
	Mean	7.08	7.83	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	6.03	7.58	7.43	7.01
	50	7.00	7.58	7.80	7.46
	75	7.55	8.03	8.15	7.91
	Mean	6.86	7.73	7.79	

C.D.(0.05) for levels of P or K = 0.43
C.D.(0.05) for variety = 0.37
C.D.(0.05) for combination of P and K = 0.73
C.D.(0.05) for combination of V and P or V and K = 0.60

FIG 3 EFFECT OF PHOSPHORUS AND POTASSIUM ON YIELDS OF POD AND HAULM, NUMBER OF PEGS PER PLANT, NUMBER OF MATURE PODS PER PLANT AND PERCENTAGE OF PEGS DEVELOPED TO MATURE PODS



analysis of variance table is presented in Appendix XII. The mean values are furnished in Table 10.

The effect of phosphorus was significant and the maximum percentage was recorded by the lowest level of 50 kg P_2O_5 per hectare. As the level of phosphorus was increased the percentage of pegs developed to mature pods significantly decreased and the minimum percentage was recorded by 100 kg P_2O_5 per hectare.

The effect of potassium was also similar to that of phosphorus. Potassium at the rate of 50 kg and 75 kg K_2O per hectare significantly reduced the percentage of mature pods over 25 kg K_2O per hectare. But the difference between 50 kg and 75 kg K_2O per hectare was not significant.

The varieties TMV-2 and TMV-9 had no significant difference in percentage of pegs developed to mature pods.

4. <u>Weight of mature pods per plant.</u>

The data on the average weight of mature pods per plant were analysed and the analysis of variance is furnished in Appendix XIII. The mean values are presented in Table 11.

The effect of phosphorus was significant in both the higher levels and the maximum weight was recorded by 100 kg P_2O_5 per hectare.

Higher levels of potassium significantly increased the weight of mature pods. The highest level, 75 kg K_2O per

Table 10. Percentage of pegs developed to mature pods (after angular transformation)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	48.26	47.66	47.96
	75	41.98	40.03	41.01
	100	35.54	34.17	34.86
K_2O kg/ha	25	44.01	43.48	43.75
	50	42.17	39.32	40.75
	75	39.60	39.05	39.33
	Mean	41.93	40.79	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	49.57	45.02	36.65	43.75
	50	48.93	38.92	34.39	40.75
	75	45.39	39.07	33.52	39.33
	Mean	47.96	41.01	34.86	

C.D.(0.05) for levels of P or K = 1.99
C.D.(0.05) for variety = 1.62
C.D.(0.05) for combination of P and K = 3.43

Table 11. Mean weight of mature pods per plant (g)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	5.63	6.18	5.91
	75	6.36	6.97	6.67
	100	6.63	7.30	6.97
K_2O kg/ha	25	5.61	6.32	5.97
	50	6.52	7.00	6.76
	75	6.49	7.13	6.81
	Mean	6.21	6.82	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	4.96	6.05	6.88	5.97
	50	6.21	6.93	7.14	6.76
	75	6.54	7.01	6.89	6.81
	Mean	5.91	6.67	6.97	

C.D.(0.05) for levels of P or K = 0.30
C.D.(0.05) for Variety = 0.22
C.D.(0.05) for combination of P and K = 0.48
C.D.(0.05) for combination of V and P or V and K = 0.39

hectare, recorded the highest weight but it was on par with 50 kg K_2O per hectare. The maximum weight of pods per plant (7.14 g) was obtained by the combination of 100 kg P_2O_5 and 50 kg K_2O per hectare.

TMV-9 produced significantly higher weight of mature pods per plant over TMV-2.

5. Yield of pods per hectare.

The data on the yield of pods per plot were analysed and the analysis of variance table is given in Appendix XIV. The mean values of pods per hectare are presented in Table 12.

The results show that the yield of pods increased by different levels of phosphorus and potassium. Higher levels of phosphorus significantly increased the yield of pods over the level of 50 kg P_2O_5 per hectare. The maximum pod yield (2014.09 kg/ha) was obtained by 100 kg P_2O_5 per hectare but was on par with the yield of 75 kg P_2O_5 per hectare.

Potassium at higher levels significantly increased the yield of pods upto 75 kg K_2O per hectare. The differences between the levels were significant. K_2O at 75 kg per hectare produced a maximum yield of 2023.15 kg pods per hectare.

The variety TMV-9 was found to be significantly superior to TMV-2 in the production of pods per hectare with an average yield of 1999.58 kg compared to 1802.68 kg of the latter.

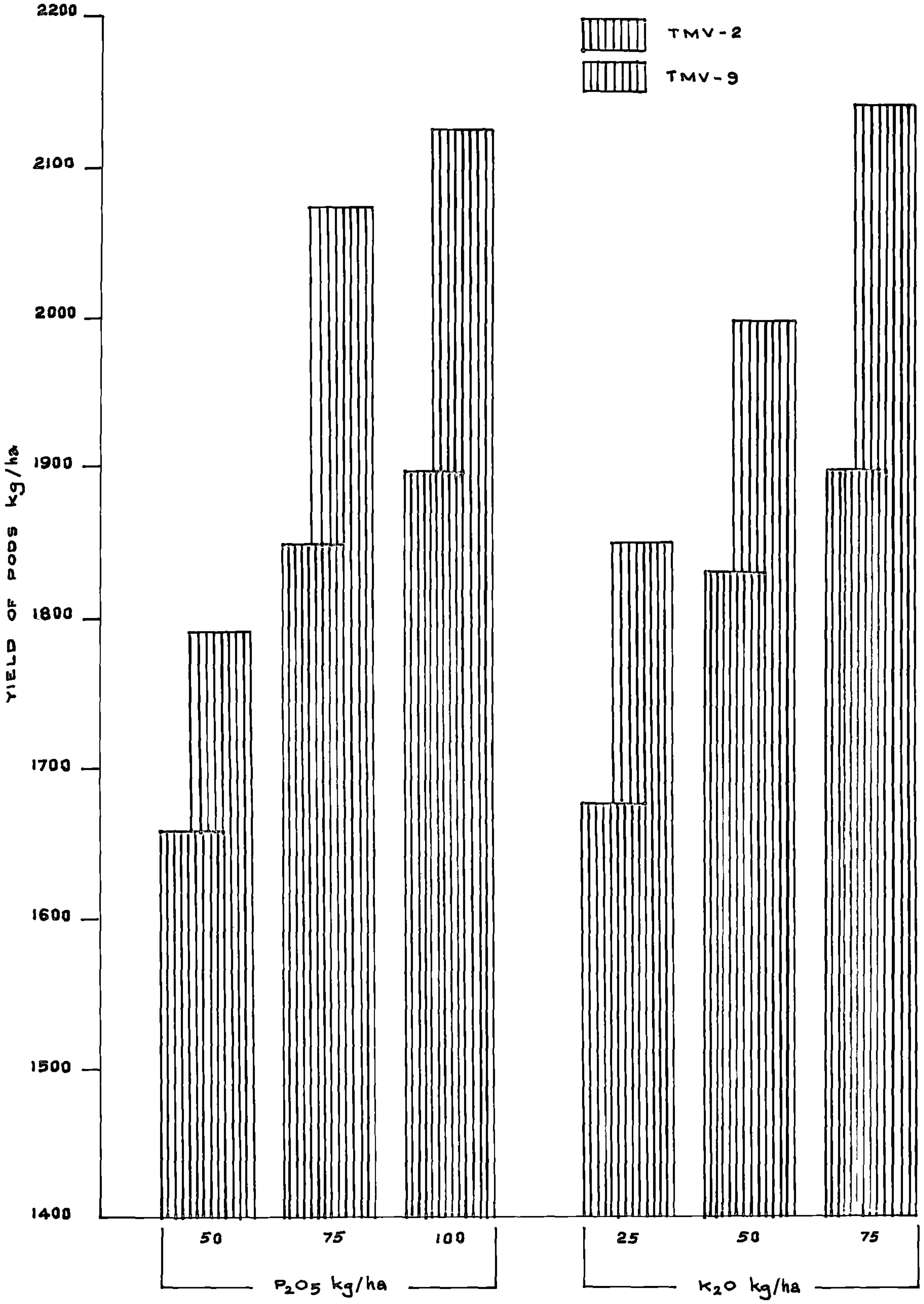
Table 12. Yield of groundnut pods per hectare (kg)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	1659.51	1792.93	1726.22
	75	1848.90	2077.02	1962.96
	100	1899.41	2128.77	2014.09
K_2O kg/ha	25	1674.24	1855.22	1764.73
	50	1832.91	1998.32	1915.62
	75	1901.09	2145.20	2023.15
	Mean	1802.68	1999.58	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	1464.65	1835.02	1994.95	1764.73
	50	1776.09	1961.29	2007.57	1915.62
	75	1936.03	2091.75	2041.24	2023.15
	Mean	1726.22	1962.96	2014.09	

C.D.(0.05) for levels of P or K = 90.91
C.D.(0.05) for variety = 74.25
C.D.(0.05) for combination of P and K = 128.57
C.D.(0.05) for combinations of V and P or V and K = 157.46

FIG 4 YIELD OF PODS kg/ha FOR DIFFERENT LEVELS OF PHOSPHORUS AND POTASSIUM



6. Yield of haulm per hectare.

The yield of haulm per hectare was analysed and the analysis of variance table is presented in Appendix XV. The mean values are shown in Table 13.

Phosphorus at 100 kg P_2O_5 per hectare significantly increased the yield of haulm over 75 kg and 50 kg P_2O_5 per hectare. The yield of haulm due to application of 75 kg P_2O_5 was significantly superior to that of 50 kg P_2O_5 per hectare.

The increase in the yield of haulm by potassium application was found to be upto 75 kg K_2O per hectare. The differences in yield were significant between all the three levels of potassium.

The yield of haulm of variety TMV-9 was significantly higher to that of TMV-2.

7. Percentage of two seeded pods.

The analysis of variance for the data is given in Appendix XVI. The mean values are presented in Table 14.

None of the treatments had any effect in the percentage of two seeded pods.

8. Natural test weight.

The data on the natural test weight of pods in gram per litre were analysed and the analysis of variance table is given in Appendix XVII. The mean values are presented in Table 15.

Table 13. Yield of groundnut haulm (kg/ha)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	3911.19	4344.27	4127.94
	75	4432.66	4958.75	4695.70
	100	4569.44	5293.35	4931.39
K_2O kg/ha	25	3842.59	4363.21	4103.11
	50	4476.85	4932.66	4704.96
	75	4593.85	5300.08	4946.97
	Mean	4304.29	4365.32	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	3347.22	4212.12	4749.57	4103.11
	50	4296.29	4848.74	4968.43	4704.96
	75	4740.32	5025.25	5075.75	4946.97
	Mean	4127.94	4695.70	4931.39	

C.D.(0.05) for levels of P or K = 228.75
C.D.(0.05) for variety = 186.74
C.D.(0.05) for combination of P and K = 396.25
C.D.(0.05) for combinations of V and P or V and K = 323.54

Table 14. Percentage of 2 seeded pods (after angular transformation)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	69.30	69.23	69.27
	75	72.27	68.73	70.50
	100	71.40	70.51	70.95
K_2O kg/ha	25	68.61	67.87	68.24
	50	72.68	70.32	71.50
	75	71.68	70.28	70.98
	Mean	70.99	69.49	N.S.

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	68.48	67.27	68.98	68.24
	50	71.30	71.23	71.97	71.50
	75	68.03	73.01	71.91	70.98
	Mean	69.27	70.50	70.95	N.S.

N.S. - Not significant

Table 15. Natural test weight of pods in grams per litre

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	263.33	249.33	256.33
	75	264.83	257.83	261.17
	100	272.17	266.50	269.33
K_2O kg/ha	25	250.00	249.17	249.58
	50	270.69	261.67	266.17
	75	279.33	262.89	271.08
	Mean	266.67	257.89	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	243.50	233.00	272.25	249.58
	50	260.75	266.25	271.50	266.17
	75	264.75	284.25	264.25	271.08
	Mean	256.33	261.17	269.33	

C.D.(0.05) for levels of P or K = 7.36
C.D.(0.05) for variety = 6.42
C.D.(0.05) for combination of P and K = 13.63
C.D.(0.05) for combinations of V and P or V and K = 11.13

The results show that effects of variety, phosphorus and potassium were significant. Phosphorus level of 100 kg P_2O_5 per hectare significantly increased the natural test weight over the levels of 75 kg and 50 kg P_2O_5 per hectare which in turn were not significant among themselves.

Potassium application progressively increased the natural test weight and showed significant differences at 50 kg and 75 kg K_2O per hectare. But the difference between 50 kg and 75 kg K_2O per hectare was not significant.

TMV-2 was found to have significantly higher test weight than that of TMV-9.

9. <u>Weight of 100 pods</u>.

The analysis of variance table for 100 pod weight is given in Appendix XVIII and the mean values are presented in Table 16.

The two higher levels of phosphorus gave significantly higher 100 pod weight when compared with the lowest level of 50 kg P_2O_5 per hectare. But the difference between 75 kg and 100 kg P_2O_5 per hectare was not significant.

Similarly potassium also increased the 100 pod weight. K_2O at the rate of 50 kg per hectare gave the highest 100 pod weight and was significantly higher to that of 25 kg K_2O per hectare. However, the difference between 50 kg and 75 kg K_2O per hectare was not significant.

Table 16. Mean weight of 100 pods (g)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	82.22	81.88	82.05
	75	83.57	83.19	83.38
	100	83.35	83.02	83.18
K_2O kg/ha	25	82.22	82.18	82.20
	50	83.70	83.08	83.39
	75	83.22	82.82	83.02
	Mean	83.04	82.69	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	81.03	82.68	82.90	82.20
	50	82.70	83.858	83.63	83.39
	75	82.43	83.60	83.03	83.02
	Mean	82.05	83.38	83.18	

C.D.(0.05) for levels of P or K = 0.56
C.D.(0.05) for variety = 0.46
C.D.(0.05) for combinations of P and K = 0.98

The hundred pod weights of the two varieties were not significantly different.

10. <u>Weight of 100 kernels.</u>

The data on 100 kernel weight were analysed and the analysis of variance table is furnished in Appendix XIX. Table 17 presents the mean values.

It is seen that phosphorus levels of 75 kg and 100 kg P_2O_5 per hectare significantly increased the weight of 100 kernels over that of 50 kg P_2O_5 per hectare. But the difference between the higher levels was not significant.

Applications of potassium at the rates of 50 kg and 75 kg K_2O per hectare increased the 100 kernel weight over that of the level of 25 kg K_2O per hectare. Here also the difference between the two higner levels was not significant.

The 100 kernel weight of TMV-2 was significantly higher than that of TMV-9.

11. <u>Shelling percentage.</u>

The Appendix XX furnishes the analysis of variance table for the shelling percentage and the Table 18 presents the mean values of the data.

Phosphorus and potassium showed no effect on the shelling percentage while the variety TMV-2 gave significantly higher shelling outturn over TMV-9.

Table 17. Mean weight of 100 kernels (g)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	34.33	34.00	34.17
	75	35.92	35.50	35.71
	100	36.17	35.25	35.71
K_2O kg/ha	25	34.42	33.92	34.17
	50	36.08	35.42	35.75
	75	35.92	35.42	35.67
	Mean	35.47	34.92	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	33.25	34.38	34.88	34.17
	50	34.88	35.88	36.50	35.75
	75	34.38	36.88	35.75	35.67
	Mean	34.17	35.71	35.71	

C.D.(0.05) for levels of P or K = 0.61
C.D.(0.05) for variety = 0.50
C.D.(0.05) for combinations of P and K = 1.06
C.D.(0.05) for combinations of V and P or V and K = 0.86

Table 18. Shelling percentage

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	74.33	73.17	73.75
	75	74.75	74.17	74.46
	100	75.25	74.33	74.79
K_2O kg/ha	25	74.33	73.33	73.83
	50	74.50	74.25	74.38
	75	75.50	74.08	74.79
	Mean	74.78	73.89	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	72.75	73.50	75.25	73.83
	50	74.00	74.75	74.38	74.38
	75	74.50	75.13	74.75	74.79
	Mean	73.75	74.46	74.79	

C.D.(0.05) for variety = 0.84

C. Quality Factors

1. Protein content of kernels.

The analysis of variance table for the data is given in Appendix XXI and the corresponding mean values are presented in Table 19.

It is seen that phosphorus levels significantly increased the protein content of kernels and a maximum protein content of 27.24 per cent was recorded by 100 kg P_2O_5 per hectare.

On the other hand, higher levels of potassium evidently affected the protein content of kernels. The highest protein content of 26.99% was observed in plots receiving 25 kg K_2O per hectare.

TMV-2 had a significantly higher percentage of protein content than TMV-9.

2. Oil content of kernel.

The data on oil content have been analysed and the analysis of variance table is given in Appendix XXII. The Table 20 presents the mean values.

It is seen from the mean values that phosphorus had no significant influence on oil content of kernels. The oil content was significantly increased by the higher levels of potassium and the highest percentage of oil (50.43) was produced by 75 kg K_2O per hectare.

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	26.49	26.86	27.61	26.99
	50	26.38	26.64	27.16	26.73
	75	26.05	26.43	26.94	26.47
	Mean	26.30	26.64	27.24	

C.D.(0.05) for levels of P or K = 0.12
C.D.(0.05) for variety = 0.10
C.D.(0.05) for combinations of P and K = 0.22
C.D.(0.05) for combinations of V and P or V and K = 0.19

Table 19. Protein content in kernel (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	26.29	26.31	26.30
	75	26.72	26.56	26.64
	100	27.37	27.10	27.24
K_2O kg/ha	25	27.08	26.90	26.99
	50	26.81	26.64	26.73
	75	26.49	26.45	26.47
	Mean	26.79	26.66	

Table 20. Oil content in kernel (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	48.43	50.89	49.66
	75	48.58	50.90	49.74
	100	48.27	50.80	49.54
K_2O kg/ha	25	43.87	50.15	49.01
	50	48.12	50.83	49.50
	75	49.30	51.55	50.43
	Mean	48.43	50.86	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	48.89	49.05	49.10	49.01
	50	49.53	49.45	49.53	49.50
	75	50.58	50.73	49.98	50.43
	Mean	49.66	49.74	49.54	

C.D.(0.05) for levels of P or K = 0.43
C.D.(0.05) for variety = 0.30
C.D.(0.05) for combinations of V and P or V and K = 0.58

TMV-9 recorded significantly more oil percentage than TMV-2. The content of oil in TMV-9 was notably higher than that of TMV-2 even with the lowest levels of P and K applications.

D. Chemical Composition and Uptake of Nutrients

1. Nitrogen content of haulm.

The percentage nitrogen content of haulm was analysed and the analysis of variance table is presented in Appendix XXIII. The mean values are shown in Table 21.

It is seen from the analysis that there was significant difference in the nitrogen content due to variety, phosphorus and potassium.

Nitrogen content in haulm was significantly higher with 100 kg P_2O_5 per hectare and was significantly more than that of the lower levels. But it was noticed that the difference between the levels of 75 kg and 50 kg P_2O_5 per hectare was not significant.

Higher levels of potassium progressively increased the nitrogen content in haulm and the maximum was reached at the highest level of K_2O.

TMV-9 showed significantly higher nitrogen content in haulm than that of TMV-2.

Table 21. Nitrogen content in haulm (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	1.63	1.67	1.65
	75	1.64	1.68	1.66
	100	1.89	1.92	1.91
K_2O kg/ha	25	1.63	1.71	1.67
	50	1.73	1.77	1.75
	75	1.79	1.80	1.80
	Mean	1.72	1.76	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	1.57	1.58	1.86	1.67
	50	1.67	1.67	1.90	1.75
	75	1.72	1.72	1.95	1.80
	Mean	1.65	1.66	1.91	

C.D.(0.05) for levels of P or K = 0.043
C.D.(0.05) for variety = 0.037
C.D.(0.05) for combinations of P and K = 0.078
C.D.(0.05) for combinations of V and P or V and K = 0.063

2. Nitrogen content of shell.

The analysis of variance table is given in Appendix XXIV and the mean values are presented in Table 22.

It is seen that the nitrogen content of shell was affected by the levels of phosphorus and potassium. Though phosphorus levels progressively increased the nitrogen content of shell, only 100 kg P_2O_5 per hectare showed a significant difference over the lower levels.

The graded levels of potassium were found to decrease the nitrogen content of shell. A maximum nitrogen content was found with 25 kg K_2O per hectare which was significantly higher than those of 50 kg and 75 kg K_2O per hectare.

There was no significant difference in the nitrogen content of shell between the varieties.

3. Nitrogen content of kernels.

The data on the nitrogen content of kernel have been analysed and the analysis of variance table is presented in Appendix XXV. The corresponding mean values are furnished in Table 23.

It is seen that the higher levels of phosphorus significantly increased the nitrogen content of kernel.

On the other hand, potassium application at higher levels significantly decreased the nitrogen content of kernel over the lowest level. A maximum nitrogen content was observed at the level of 25 kg K_2O per hectare.

Table 23. Nitrogen content in kernel (percentage)

		T IV-2	T IV-9	Mean
P_2O_5 kg/ha	50	4.21	4.21	4.21
	75	4.28	4.25	4.26
	100	4.33	4.34	4.36
K_2O kg/ha	25	4.33	4.30	4.32
	50	4.29	4.26	4.28
	75	4.24	4.23	4.24
	Mean	4.29	4.27	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	4.24	4.30	4.42	4.32
	50	4.22	4.26	4.35	4.28
	75	4.17	4.23	4.31	4.24
	Mean	4.21	4.26	4.36	

C.D.(0.05) for levels of P or K = 0.02
C.D.(0.05) for variety = 0.02
C.D.(0.05) for combination of P and K = 0.03
C.D.(0.05) for combinations of V and P or V and K = 0.03

Table 22. Nitrogen content in shell (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	1.283	1.282	1.283
	75	1.295	1.298	1.297
	100	1.343	1.347	1.345
K_2O kg/ha	25	1.325	1.323	1.324
	50	1.305	1.310	1.308
	75	1.292	1.293	1.293
	Mean	1.307	1.309	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	1.295	1.315	1.363	1.324
	50	1.288	1.290	1.345	1.308
	75	1.265	1.285	1.328	1.293
	Mean	1.283	1.297	1.345	

C.D.(0.05) for levels of P or K = 0.015
C.D.(0.05) for variety = 0.012
C.D.(0.05) for combinations of P and K = 0.026

The kernels of TMV-2 was found to have a higher content of nitrogen than TMV-9.

4. <u>Total uptake of nitrogen.</u>

The data on the total uptake of nitrogen by the crop in kg per hectare were analysed and the analysis of variance is given in Appendix XXVI. The mean values are presented in Table 24.

It was found that the effects of phosphorus, potassium and variety were significant. There were significant differences between the levels of P_2O_5. The highest uptake of 101.64 kg N per hectare was recorded by 100 kg P_2O_5 per hectare and it was significantly superior to 75 kg and 50 kg P_2O_5 per hectare. So also, the uptake at the level of 75 kg was significantly higher than at 50 kg P_2O_5 per hectare.

Potassium also significantly increased the nitrogen uptake with a maximum of 98.5 kg N per hectare at 75 kg K_2O level.

The crop removal of nitrogen by TMV-9 was 95.73 kg N per hectare which was significantly higher than that by TMV-2.

5. <u>Phosphorus content of haulm.</u>

The Appendix XXVII represents the analysis of variance table for percentage of phosphorus content of haulm. The mean values are presented in Table 25. It is seen that the

Table 24. Uptake of nitrogen (kg/ha)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	78.50	83.21	80.86
	75	88.86	97.71	93.29
	100	97.00	106.27	101.64
K_2O kg/ha	25	80.33	87.33	84.08
	50	90.31	96.09	93.20
	75	93.72	103.27	98.50
	Mean	88.12	95.73	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	66.74	85.35	100.15	84.08
	50	84.06	94.24	101.29	93.20
	75	91.76	100.27	103.46	98.50
	Mean	80.86	93.29	101.64	

C.D.(0.05) for levels of P or K = 4.67
C.D.(0.05) for variety = 3.81
C.D.(0.05) for combination of P and K = 8.09
C.D.(0.05) for combinations of V and P or V and K = 6.61

Table 25. Phosphorus content of haulm (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	0.239	0.253	0.246
	75	0.253	0.272	0.263
	100	0.273	0.277	0.275
K_2O kg/ha	25	0.250	0.272	0.261
	50	0.250	0.263	0.257
	75	0.265	0.267	0.266
	Mean	0.255	0.267	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	0.240	0.263	0.280	0.261
	50	0.250	0.255	0.265	0.257
	75	0.249	0.270	0.280	0.266
	Mean	0.246	0.263	0.275	

C.D.(0.05) for levels of P or K = 0.016
C.D.(0.05) for variety = 0.013

levels of phosphorus had significant influence on the phosphorus content of haulm and the highest content was 0.275 per cent at 100 kg P_2O_5 per hectare. Phosphorus though, had influence in the phosphorus content of haulm, its effect was significant only upto 75 kg P_2O_5 per hectare.

Potassium had no effect on the phosphorus content of haulm. The effect of combination was also not significant. The varietal response was not significantly different regarding the phosphorus content of haulm.

6. Phosphorus content of shell.

The analysis of variance table is given in Appendix XXVIII and the mean values are presented in Table 26.

It was noted that phosphorus content of shell was significantly increased due to increased levels of P_2O_5. By application of 100 kg P_2O_5 per hectare the percentage of 'P' in the shell was increased by 0.019 over that of 25 kg P_2O_5 per hectare.

Potassium levels of 50 kg and 75 kg K_2O per hectare were on par and were significantly superior to 25 kg K_2O per hectare in increasing the P content of shell.

The difference between the varieties was not significant.

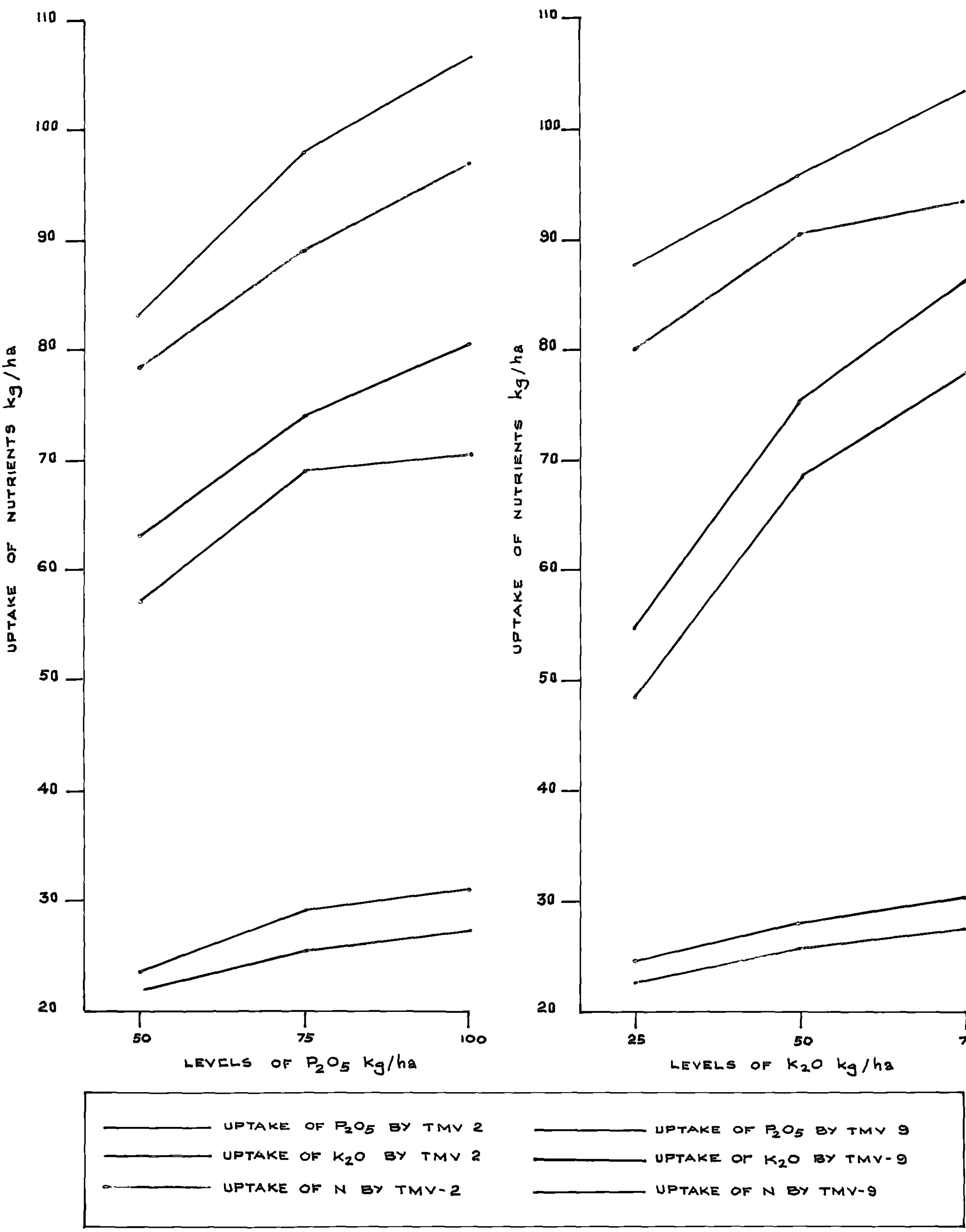
Table 26. Phosphorus content of shell (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	0.092	0.090	0.091
	75	0.100	0.100	0.100
	100	0.110	0.110	0.110
K_2O kg/ha	25	0.090	0.093	0.092
	50	0.102	0.103	0.103
	75	0.110	0.103	0.107
	Mean	0.101	0.100	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	0.083	0.093	0.100	0.092
	50	0.098	0.100	0.110	0.103
	75	0.093	0.108	0.120	0.107
	Mean	0.091	0.100	0.110	

C.D.(0.05) for levels of P or K = 0.008
C.D.(0.05) for variety = 0.007
C.D.(0.05) for combinations of P and K = 0.015

FIG 5 UPTAKE OF NUTRIENTS BY VARIETIES TMV-2 AND TMV-9



7. Phosphorus content of kernel.

The analysis of variance and the mean values are presented in Appendix XXIX and Table 27 respectively.

Phosphorus application was found to increase the phosphorus content of kernel significantly. At 75 kg and 100 kg P_2O_5 per hectare phosphorus increased the P content by 0.023 and 0.013 per cent respectively over their lower level of phosphorus fertilization.

Potassium levels of 50 kg and 75 kg K_2O per hectare were on par and significantly increased the phosphorus content over that of 25 kg K_2O per hectare. There was no significant difference between the varieties.

8. Total uptake of phosphorus.

The data on total uptake of phosphorus were analysed and the analysis of variance is furnished in Appendix XXX. The mean values are presented in Table 28. It was found that the effects of variety, phosphorus and potassium were significant. Phosphorus levels progressively and significantly increased the total uptake of phosphorus by the crop. The maximum uptake of 29.43 kg P_2O_5 was noticed at 100 kg P_2O_5 per hectare level.

Similarly increasing levels of potassium also increased the uptake of phosphorus.

Table 27. Phosphorus content of kernel (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	0.490	0.507	0.499
	75	0.520	0.523	0.522
	100	0.537	0.533	0.535
K_2O kg/ha	25	0.503	0.500	0.502
	50	0.517	0.527	0.522
	75	0.527	0.537	0.532
	Mean	0.516	0.521	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	0.480	0.505	0.520	0.502
	50	0.490	0.525	0.550	0.522
	75	0.525	0.535	0.535	0.532
	Mean	0.499	0.522	0.535	

C.D.(0.05) for levels of P or K = 0.012
C.D.(0.05) for variety = 0.010
C.D.(0.05) for combinations of P and K = 0.022

Table 28. Uptake of phosphorus (kg P_2O_5/ha)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	21.78	23.84	22.81
	75	25.97	29.04	27.50
	100	28.08	30.75	29.43
K_2O kg/ha	25	22.53	25.01	23.77
	50	25.65	28.08	26.86
	75	27.62	30.55	29.08
	Mean	25.28	27.87	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	18.21	24.62	28.51	23.77
	50	23.45	27.59	29.52	26.86
	75	26.77	30.30	30.23	29.08
	Mean	22.81	27.50	29.43	

C.D.(0.05) for levels of P or K = 1.62
C.D.(0.05) for variety = 1.28
C.D.(0.05) for combinations of P and K = 2.77
C.D.(0.05) for combinations of V and P or V and K = 2.27

As in the case of nitrogen uptake, phosphorus uptake by TMV-9 was also significantly higher than that by TMV-2.

9. Potassium content of haulm.

The data on percentage of potassium content in haulm were analysed. The analysis of variance and mean values are furnished in Appendix XXXI and Table 29 respectively.

Phosphorus application had no effect on the potassium content of haulm.

Higher levels of potassium significantly increased the potassium content of haulm and there were significant differences between all the three levels. K_2O levels of 50 kg and 75 kg increased the K content by 0.67 per cent and 0.2 per cent respectively over those of the immediate lower levels.

There was no difference in potassium content between the varieties.

10. Potassium content of shell.

The data of percentage of potassium content of shell were analysed and the analysis of variance is given in Appendix XXXII. The corresponding mean values are presented in Table 30.

The results show that phosphorus and potassium had independently influenced the potassium content of shell. Phosphorus at 75 kg and 100 kg P_2O_5 per hectare increased

Table 29. Potassium content in haulm (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	2.53	2.67	2.60
	75	2.65	2.72	2.69
	100	2.65	2.80	2.73
K_2O kg/ha	25	2.10	2.22	2.16
	50	2.75	2.90	2.83
	75	2.98	3.07	3.03
	Mean	2.61	2.73	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	2.05	2.13	2.30	2.16
	50	2.78	2.83	2.88	2.83
	75	2.98	3.10	3.00	3.03
	Mean	2.60	2.69	2.73	

C.D.(0.05) for levels of P or K = 0.18
C.D.(0.05) for variety = 0.14

Table 30. Potassium content in shell (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	1.133	1.150	1.142
	75	1.217	1.267	1.242
	100	1.267	1.350	1.309
K_2O kg/ha	25	1.067	1.100	1.084
	50	1.200	1.267	1.234
	75	1.350	1.400	1.375
	Mean	1.206	1.256	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	1.000	1.100	1.151	1.084
	50	1.175	1.225	1.301	1.234
	75	1.250	1.400	1.475	1.375
	Mean	1.142	1.242	1.309	

C.D.(0.05) for levels of P or K = 0.071
C.D.(0.05) for variety = 0.058
C.D.(0.05) for combinations of P and K = 0.123

the potassium content of shell but the difference between them was not significant.

Potassium at higher levels increased the potassium content and a maximum K content of 1.375 per cent was found at 75 kg K_2O per hectare. Here also, the difference in K content between the varieties was not significant.

11. <u>Percentage of potassium content in kernel</u>.

The analysis of variance table and the mean values are presented in Appendix XXXIII and Table 31 respectively.

The analysis of variance show that the potassium content of kernel was not significantly affected by levels of phosphorus. Potassium application significantly increased the potassium content of kernel but the higher levels of 50 kg and 75 kg K_2O were on par. There were no varietal difference in the potassium content of kernel.

12. <u>Total uptake of potassium</u>.

The data were analysed and the analysis of variance table is furnished in Appendix XXXIV. The mean values are presented in Table 32.

The results show that the effects of phosphorus, potassium and variety were significant. Higher levels of P_2O_5 (75 kg and 100 kg/ha) were found to have significantly increased the uptake of potassium over the lower level (50 kg) while the difference between the higher levels was

Table 31. Potassium content in kernel (percentage)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	0.817	0.867	0.842
	75	0.900	0.900	0.900
	100	0.917	0.933	0.925
K_2O kg/ha	25	0.783	0.783	0.783
	50	0.883	0.933	0.908
	75	0.967	0.983	0.975
	Mean	0.878	0.900	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	0.725	0.800	0.825	0.783
	50	0.850	0.925	0.950	0.908
	75	0.950	0.975	1.000	0.975
	Mean	0.842	0.900	0.925	

C.D.(0.05) for levels of P or K = 0.074
C.D.(0.05) for variety = 0.061

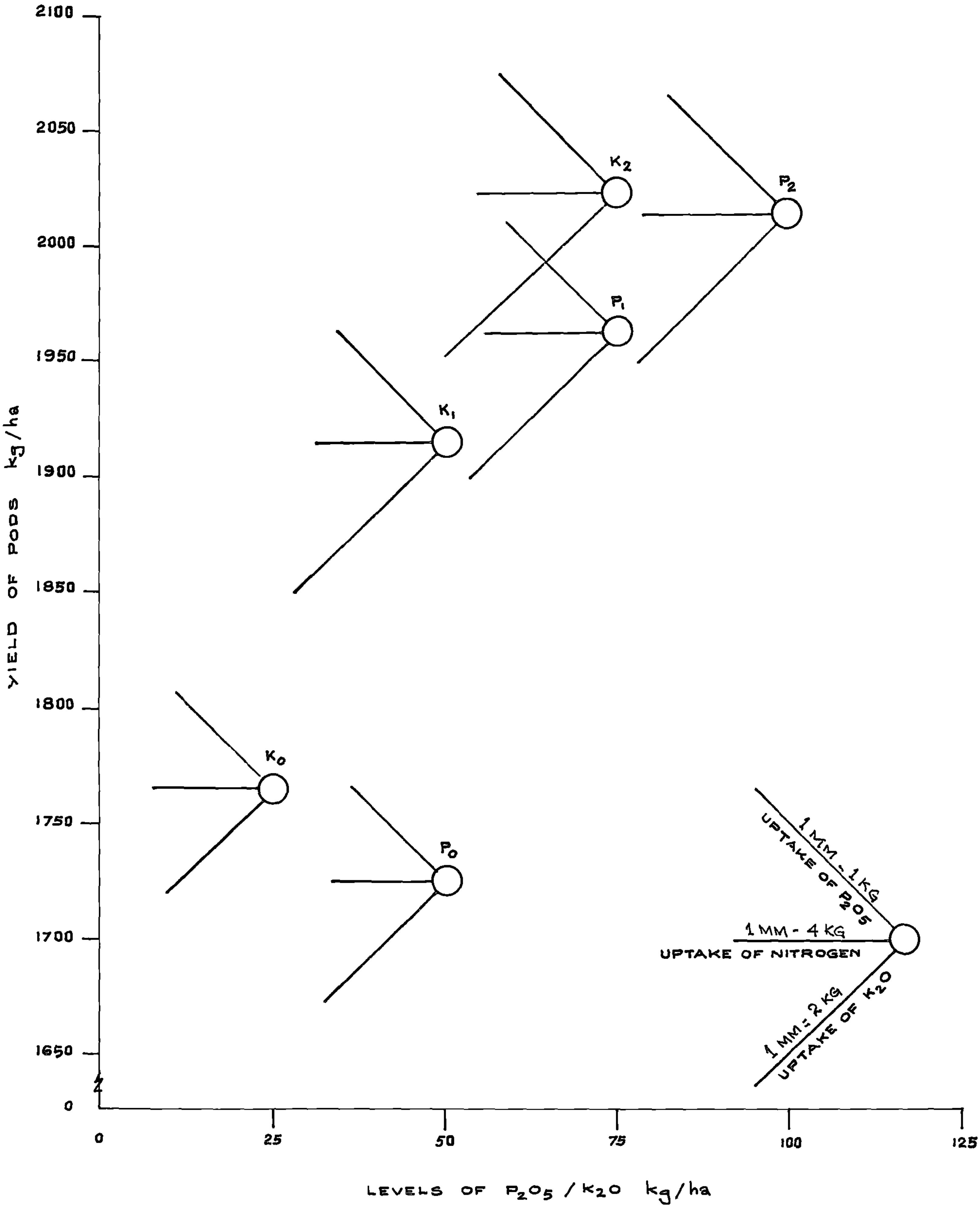
Table 32. Uptake of potassium (K_2O kg/ha)

		TMV-2	TMV-9	Mean
P_2O_5 kg/ha	50	57.31	63.12	60.22
	75	68.33	74.30	71.32
	100	70.14	80.39	75.26
K_2O kg/ha	25	48.90	55.13	52.02
	50	69.02	75.91	72.46
	75	77.85	86.77	82.32
	Mean	65.25	72.60	

		P_2O_5 kg/ha			
		50	75	100	Mean
K_2O kg/ha	25	39.57	53.59	62.88	52.02
	50	64.16	74.90	78.33	72.46
	75	76.94	85.44	84.58	82.32
	Mean	60.22	71.32	75.26	

C.D.(0.05) for levels of P or K = 5.40
C.D.(0.05) for variety = 4.41
C.D.(0.05) for combinations of P and K = 9.36
C.D.(0.05) for combinations of V and P or V and K = 7.64

FIG 6 EFFECT OF PHOSPHORUS AND POTASSIUM ON YIELD OF PODS AND UPTAKE OF NITROGEN, PHOSPHORUS AND POTASSIUM



not significant.

Potassium at 50 kg and 75 kg K_2O per hectare increased the potassium uptake by the crop over that of 25 kg K_2O per hectare. The increases by the level of 75 kg K_2O over those of 50 kg and 25 kg K_2O per hectare were 9.86 kg and 30.3 kg respectively. The uptake of K_2O by TMV-9 was found to be significantly superior to that of TMV-2.

D. Correlation Studies

The values of simple correlation coefficients are presented in Table 33.

Yield of pods was significantly and positively correlated with haulm yield. Yield attributes like number of pogs formed per plant, number of mature pods per plant and 100 pod weight were correlated with yield of pods and the corresponding 'r' values (0.809, 0.927 and 0.603) were found positive and significant. Correlation of pod yield with the uptake of nitrogen, phosphorus and potassium and weight of root nodules per plant at 90th day after sowing showed that the correlations were significant and positive. It was further noticed that the uptake of nitrogen, phosphorus and potassium were positively and significantly correlated with number of pegs formed per plant, number of

Table 33. Values of simple correlation coefficients

Sl.No.	Characters correlated	Correlation coefficient
1.	Yield of pod and yield of haulm	0.984*
2.	Yield of pod and number of pegs formed per plant	0.809*
3.	Yield of pod and number of pods per plant	0.927*
4.	Yield of pod and 100 pod weight	0.603*
5.	Yield of pod and nitrogen uptake	0.966*
6.	Yield of pod and phosphorus uptake	0.973*
7.	Yield of pod and potassium uptake	0.874*
8.	Yield of pod and weight of root nodules per plant	0.675*
9.	Nitrogen uptake and number of pegs formed per plant	0.893*
10.	Nitrogen uptake and number of pods per plant	0.880*
11.	Nitrogen uptake and 100 pod weight	0.666*
12.	Phosphorus uptake and number of pegs formed per plant	0.885*
13.	Phosphorus uptake and number of pods per plant	0.894*
14.	Phosphorus uptake and 100 pod weight	0.680*
15.	Phosphorus uptake and oil content of kernel	0.540*
16.	Potassium uptake and number of pegs formed per plant	0.737*
17.	Potassium uptake and number of pods per plant	0.720*
18.	Potassium uptake and 100 pod weight	0.661*
19.	Potassium uptake and oil content of kernel	0.587*

*Significant at 0.05 level

mature pods per plant and 100 pod weight. The data of oil content of kernel were correlated with uptake of phosphorus and potassium and the corresponding 'r' values (0.540 and 0.587) were positive and significant.

E. Response Curve and Economics of Fertilizer Application

Quadratic response curves were fitted to the data for both phosphorus and potassium to study the relationship between yield and fertilizer levels. They gave the response curve as follows:-

Phosphorus.

$$Y = 696.3912 + 280.0176P - 0.1434P^2$$

where, 'Y' is the yield of pods in kg per hectare and 'P' denotes quantity of P_2O_5 in kg per hectare (Fig.7).

Potassium.

$$Y = 1570.7121 + 8.6284K - 0.0347K^2$$

where, 'Y' is the yield of pods in kg per hectare and 'K' is the quantity of K_2O in kg per hectare (Fig.7).

The optimum level of phosphorus ($\frac{-b}{2a}$) and the economic level ($\frac{-b}{2a} + \frac{1}{2a}\frac{px}{py}$) were found to be 94 kg and 90 kg P_2O_5 per hectare respectively.

Level of potassium for optimum yield and the economic doses were found to be 124 kg and 116 kg K_2O respectively.

FIG 7 RESPONSE CURVE FOR PHOSPHORUS AND POTASSIUM

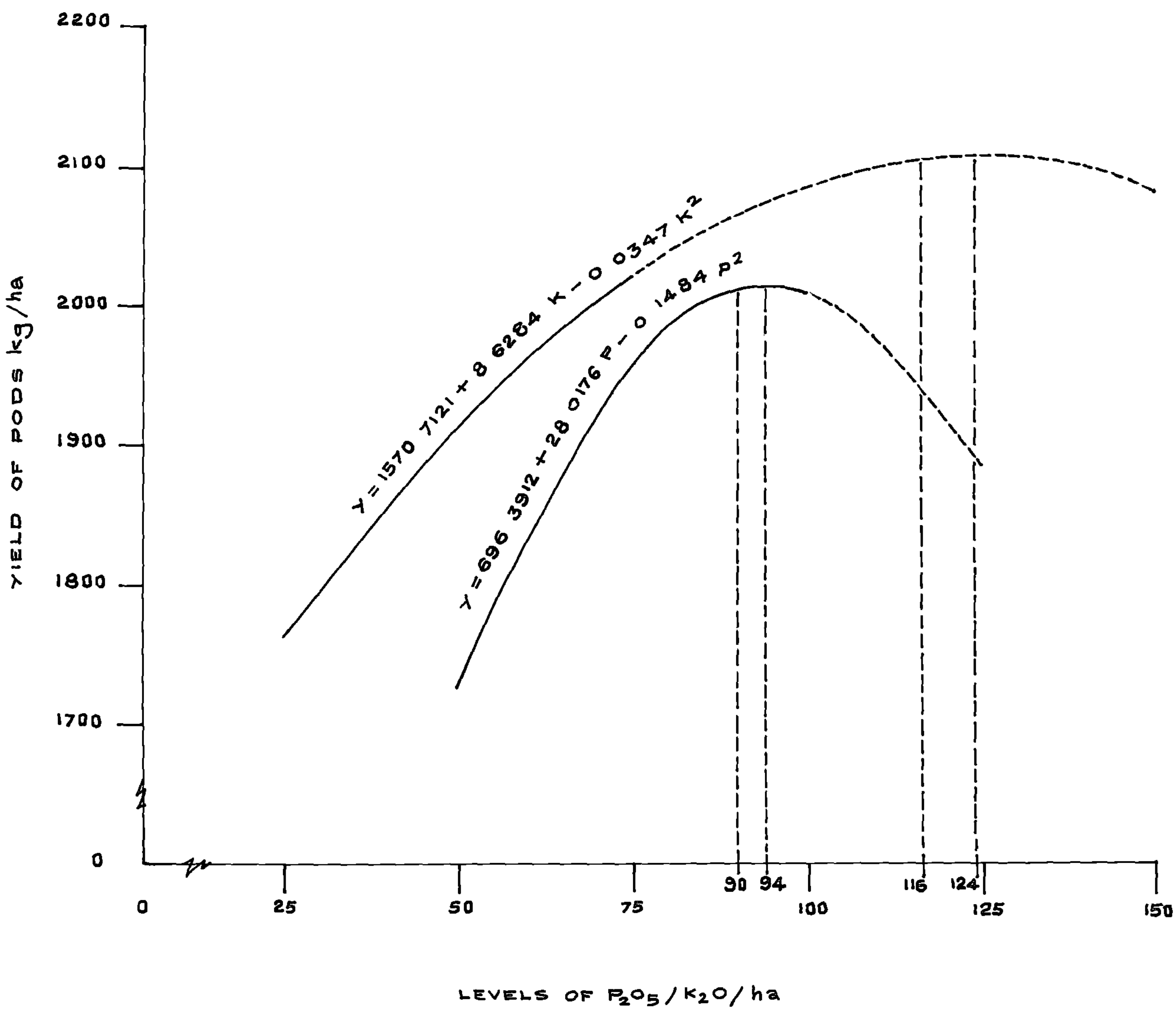


Table 34. Economics of fertiliser application

Treatments	Yield of pod in kg/ha	Value of produce Rs. Ps.	Increase or decrease over the lowest level Rs. Ps.	Cost of fertilisers (P_2O_5/K_2O) Rs. Ps.	Extra cost of fertilizers over the lowest Rs. Ps.	Profit due to the fertilizer application over the lowest level Rs. Ps.
50 kg P_2O_5/ha	1726.22	4315.55	-	175.00	-	-
75 kg ,,	1962.96	4907.40	591.85	262.50	97.50	504.35
90 kg ,,	2015.93	5039.83	724.28	315.00	140.00	584.28
94 kg ,,	2018.78	5046.95	731.40	329.00	154.00	577.40
100 kg ,,	2014.09	5035.23	719.68	350.00	175.00	544.68
125 kg ,,	1879.84	4699.60	384.05	437.50	262.50	121.55
25 kg K_2O/ha	1764.73	4411.83	-	35.00	-	-
50 kg ,,	1915.62	4789.05	377.22	70.00	35.00	342.22
75 kg ,,	2023.15	5057.88	646.05	105.00	70.00	576.05
100 kg ,,	2086.54	5216.35	804.52	140.00	105.00	699.52
116 kg ,,	2104.68	5261.70	849.87	162.40	127.40	722.47
124 kg ,,	2107.08	5267.70	855.87	173.60	138.60	717.22
125 kg ,,	2107.06	5267.65	855.82	175.00	140.00	715.82
150 kg ,,	2084.21	5210.53	798.70	210.00	175.00	623.70

Cost of 1 kg of P_2O_5 - Rs. 3.50
Cost of 1 kg of K_2O - Rs. 1.40
Cost of 1 kg of pods - Rs.2.50

The economics of fertilizer application for the estimated yields at various levels of phosphorus and potassium are given in Table 34. At economic level of P_2O_5 (90 kg/ha) the profit due to fertilizer application over the lowest level was Rs.584.28. Similarly the economic level of K_2O (116 kg per hectare) was estimated to give a profit of Rs.722.47 over the lowest level.

DISCUSSION

DISCUSSION

An investigation was carried out to study the performance of two groundnut varieties, TMV-2 and TMV-9 under graded doses of phosphorus and potassium in the College of Agriculture, Vellayani during 1976-77. The results of the experiment are discussed below:

A. Growth Characters

1. Height of plants at maturity.

The observations recorded show that phosphorus levels of 75 kg and 100 kg P_2O_5 per hectare significantly increased the height of plants compared to 50 kg P_2O_5 per hectare. A maximum height of 31.6 cm was recorded by the highest level of P_2O_5 per hectare. This shows that increased levels of phosphorus have contributed significantly for the increase in height of plants. Phosphorus encourages meristematic activity and increases the root growth (Black, 1968). Here, the increased levels provided more available phosphorus for the enriched growth and development of roots. The positive effect of phosphorus in increasing the height of plants noticed here is in corroboration with the findings of Gopalakrishnan and Nagarajan (1958), Punnoose (1968), Palaniappan (1970) and Muraleedharan (1971). Apart from the direct effect of phosphorus in increasing the height of plant, it has influenced the growth by increasing the absorption of nitrogen indirectly as seen from Table 21.

Potassium levels of 50 kg and 75 kg K_2O per hectare significantly increased the height of plants over 25 kg K_2O. Potassium also is reported to be essential for the promotion of growth of the meristematic tissue (Tisdale and Nelson, 1975). The result obtained in this experiment is in conformity with the findings of Veeraraghavan (1964).

The results given in Table 1 further showed that the differences in height between TMV-2 and TMV-9 were not significant, indicating their similarity in this character.

2. Number of branches per plant.

The results presented in Table 2 showed that the number of branches per plant was not significantly influenced by any of the treatments. However, the trend of the results indicated the positive influence of higher levels of phosphorus and potassium in increasing the number of branches per plant. Identical results were earlier reported by Puntamkar and Bathkal (1967) and Punnoose (1968).

There was no difference between the varieties TMV-2 and TMV-9 regarding their branching characters, thereby showing that these two varieties are alike with respect to this character.

3. Number of leaves per plant.

Though phosphorus levels progressively increased the number of leaves, significant difference is seen only between 50 kg and 100 kg P_2O_5 per hectare. This increase in the number of leaves might be due to the increased cell division induced by the application of higher levels of phosphorus. Bledsoe and Harris (1950) reported that lack of phosphorus greately restricted top growth and later resulted in premature defoliation. Increase in the number of leaves by phosphorus application was also reported by Gopalakrishnan and Nagarajan (1958), Jayadevan (1970) and Muraleedharan (1971).

Application of 50 kg K_2O per hectare significantly increased the number of leaves per plant over 25 kg K_2O per hectare. The highest leaf production (65.25 leaves per plant) was found by the application of 75 kg K_2O per hectare. The increase in the number of leaves per plant might be due to the effect of potassium in the promotion of growth of meristematic tissues. Identical results were reported by Bhan and Misra (1972).

With regard to the number of leaves per plant there was no significant difference between TMV-2 and TMV-9. This might be due to the fact that both the varieties belonged to the bunch type.

4. Weight of root nodules per plant.

It was seen from the results of observations taken on 30th and 60th day after sowing that 100 kg P_2O_5 per hectare significantly increased the weight of root nodules compared to 50 kg P_2O_5. At 90th day it was found that the nodular weight was significantly increased by 75 kg and 100 kg P_2O_5 per hectare. It is evident from this that the applied phosphorus induced rapid growth of rhizobia thereby increasing the nodules in the roots. Russel (1961) and Raheja (1966) emphasised the role of phosphorus on the synthesis of the body protein of rhizobia and their multiplication. The results of the present investigation regarding nodular tissue weight are in agreement with the findings of Nijhawan (1962 b), Khare and Rai (1968), Muthusamy (1973), Punnoose and George (1975) and Pawar and Khupse (1976).

Potassium was found to have no significant effect on the nodule weight. Similar results were also reported by Veeraraghavan (1964). There was no varietal influence on the weight of root nodules.

5. Number of days taken for flowering.

The results in Table 7 revealed that the application of higher levels of phosphorus reduced the number of days taken for flowering over that of the lower levels. An adequate supply of phosphorus early in the life of the plant is important in laying down the primordia for its reproductive parts (Tisdale and Nelson, 1975). Inadequate supply of phosphorus causes a slow growth and consequently, maturity

maturity is delayed. Arnon (1953) reported that deficiency of phosphorus reduced flower production and delayed flowering. The results of this experiment are identical with the findings of Bhan and Misra (1972) and Muraleedharan et al. (1975).

Higher levels of potassium decreased the time taken for flowering and at 75 kg K_2O per hectare the plants took only 22.88 days to flower. This might be due to the better growth and vigour in the early stages of the plants by the increased availability of applied potassium. Appreciable delay in maturity due to potassium deficiency was reported by Black (1968).

The number of days taken for flowering by TMV-2 was significantly lesser than that of TMV-9. This might be due to the varietal character as reported by Anon.(1974).

B. Yield and Yield Attributes

1. Number of pegs formed per plant.

The number of pegs formed per plant was significantly increased by higher levels of phosphorus. The increase in the number of pegs might be due to the increased growth and development of plants by the effective utilization of phosphorus in the early stages. Flower production in groundnut is directly related to the vegetative growth (Goldin and Har-Tzook, 1966). Reduction in flower production and fertilization of flowers due to lack of phosphorus were reported by Gopalakrishnan and Nagarajan (1958), whereas significant increases in flower production due to increased application of phosphorus were reported by Sathyanarayana and Rao (1962), Lachover and Ebercon (1966) and Singh and Pathak (1969).

Potassium also increased the peg formation and the maximum number of pegs formed per plant (20.66) was noticed at the level of 75 kg K_2O per hectare. Identical results were obtained by Singh and Pathak (1969).

The formation of pegs in TMV-9 was higher than that of TMV-2. This might be due to the genetic character of the variety. The number of pegs formed per plant in TMV-9 was reported to be higher than that of TMV-2 (Anon., 1974).

2. <u>Number of mature pods per plant</u>.

Table 9 and Fig.3 show that phosphorus level of 75 kg P_2O_5 per hectare increased the number of pods developed per plant over 50 kg P_2O_5 per hectare and was on par with 100 kg P_2O_5 per hectare. Adequate supply of phosphorus is an important factor in fruiting and seed production (Buckman and Brady, 1969). In legumes a reserve supply of inorganic phosphorus in the plant is essential for the formation of pods because, in the grain formation stage, the inorganic phosphates combine rapidly with other organic compounds to build up the grain (Raheja, 1966). The above role of phosphorus might have contributed to this increase in the number of mature pods per plant under higher levels of P_2O_5. Similar results were reported by Sathyanarayana and Rao (1962), Jayadevan (1970) and Muraleedharan (1971).

Higher levels of potassium increased the number of pods per plant. The potassium levels of 50 and 75 kg K_2O per hectare were significantly superior to their lower levels in increasing the number of mature pods per plant. This is in agreement with the findings of Sreedharan and George (1968).

The number of mature pods per plant of TMV-9 was higher than that of TMV-2. Number of pegs formed per plant was also high in TMV-9 which might have contributed to the increase in the number of mature pods.

3. Percentage of pegs developed to mature pods.

The results showed that the higher levels of phosphorus decreased the percentage of pegs developed to mature pods per plant. This was due to the continued production of pegs upto harvest stage. The later formed pegs were not developed into mature pods. Similar results were reported by Muraleedharan et al. (1975).

Higher levels of potassium also decreased the percentage of pegs developed to mature pods but the higher levels of 50 kg and 75 kg K_2O per hectare were on par. Here also the decrease in the percentage of pegs developed to mature pods might be due to the continued production of pegs upto harvest by the higher levels of potassium.

There was no significant difference between the two varieties with respect to this observation. This shows that the percentage of pegs developed to mature pods was not influenced by the varieties.

4. Weight of mature pods per plant.

The results presented in Table 11 show that phosphorus significantly increased the weight of pods per plant upto 100 kg P_2O_5 per hectare. Increased number of pods per plant (as seen in Table 9) and the higher rate of kernel deposit might be the reason for the increased weight of pods per plant at 75 and 100 kg P_2O_5 per hectare. Increase in weight of pods per plant by phosphate fertilization has been reported by Goldin and Har-Tzook (1966), Banerjee et al. (1967), Muraleedharan (1971) and Dohatonde and Rahate (1975).

Higher levels of potassium (50 kg and 75 kg K_2O per hectare) increased the weight of mature pods per plant. Potassium, though not an integral part of the plant components, is essential for many important functions like nitrogen metabolism, carbohydrate metabolism etc.(Tisdale and Nelson, 1975). Increase in the weight of mature pods per plant by K fertilization was reported by Veeraraghavan (1964).

The weight of mature pods per plant in the variety TMV-9 was found to be higher than that of TMV-2 and this increase might be due to the varietal character as reported by Muhammed et al. (1973).

5. Yield of pods per hectare.

Table 12 and Fig.4 shows that phosphorus at 75 kg per hectare significantly increased the pod yield over 50 kg P_2O_5 per hectare, but the difference between 75 kg and 100 kg P_2O_5 per hectare (1962.96 kg and 2014.09 kg pods per hectare, respectively) was not significant. Phosphorus at 75 kg P_2O_5 per hectare increased the number of pods per plant (Table 9) and the weight of pods per plant (Table 11) over 50 kg P_2O_5 per hectare as discussed earlier. These two factors, together might have contributed to an increase in the yield of pods. Increases in the yield of pods by phosphorus fertilization were reported by many workers. Katarki and Banahatti (1965) reported significant yield increases for 112 kg P_2O_5 per hectare over that of 56 kg P_2O_5 per hectare. Similar yield increases in response to higher levels of phosphorus were also reported by Banerjee et al. (1967), Kulkarni et al. (1967), Herrera et al. (1969), Muraleedharan (1971), Nakagava et al. (1974), Joshi et al. (1975) and

Kulkarni *et al.* (1977).

The highest pod yield of 2023.15 kg per hectare was produced by the application of 75 kg K_2O per hectare which was superior to 50 and 25 kg K_2O per hectare. Increases due to potassium application were observed earlier in the number of mature pods per plant and the weight of pods per plant. Hence it should be assumed that the above factors helped in increasing the yield per hectare. Sreedharan and George (1968) found similar increase in yield by potassium application of 50 kg K_2O per hectare. Response for 60 kg K_2O per hectare in red soils was reported by Prasad and Mahapatra (1970). Similar yield increases were also reported by Raheja *et al.* (1970), Habeebulla (1973), Badanur *et al.* (1976), Gopalasamy *et al.* (1976, 1977), Natarajan *et al.* (1976) and Mustafa *et al.* (1978). Reddy *et al.* (1977) reported yield increases by 80 kg K_2O per hectare over that of lower levels and the potassium application for yield maximisation was 100.2 kg K_2O per hectare.

TMV-9 produced significantly higher yield of pods over TMV-2 and the increase was to the extent of 7.5 per cent. This increase in yield was attributed by the high yielding nature of the variety TMV-9 as was seen in other observations like number of mature pods and weight of pods per plant. Yield increases of 61.9 per cent by TMV-9 over TMV-2 was reported by Muhammed et al. (1973). Similar increase in yield by TMV-9 was also reported by Anon. (1974).

6. Yield of haulm per hectare.

The results showed that higher levels of phosphorus (75 kg and 100 kg P_2O_5 per hectare) increased the yield of haulm per hectare. The mean yield of 4931.39 kg of haulm per hectare was produced by 100 kg P_2O_5 per hectare which was superior to the lower levels. Supply of phosphorus stimulates root growth and promotes a rapid growth of the plant (Black, 1968). Bhan and Misra (1970) reported increases in root development with increased levels of phosphate application. The development of a good root system which absorbs more nutrients for the growth and development of the plant might have contributed to the higher yield of haulm per hectare.

Increases in hay yields by higher levels of phosphate application were reported by Reid and York (1958), Wahab and Mohammed (1958), Singh and Pathak (1970) and Muraleedharan (1971).

Potassium levels of 50 kg and 75 kg K_2O per hectare produced higher haulm yields over their respective lower levels and a maximum yield (4946.97 kg) was recorded at 75 kg K_2O per hectare. Potassium is an essential element for promoting the growth of meristematic cells, lack of which decreases photosynthesis and growth of plant. Increase in the growth of groundnut by application of higher doses of potassium was reported by Singh and Pathak (1969).

The yield of haulm of TMV-9 was higher than that of TMV-2 as in the case of yield of pods and this might be due to the combined influence of growth characters already discussed.

7. Percentage of two seeded pods.

Table 14 shows that none of the treatments influenced the percentage of two seeded pods. The number of seeds per pod is mostly a varietal character as reported by Seshadri (1962).

TMV-9 and TMV-2 also did not show any significant difference in percentage of two seeded pods, which shows that both the varieties are similar with respect to this character.

8. Natural test weight, 100 pod weight, 100 kernel weight and shelling percentage.

The results (Tables 15 to 17) showed that 100 kg P_2O_5 per hectare increased the natural test weight, 100 pod weight and 100 kernel weight over those of 50 kg P_2O_5 per hectare. Phosphorus is considered essential for seed formation and is found in large quantities in seed.

Jayadevan (1970) and Muraleedharan (1971) reported that higher levels of phosphorus increased natural test weight, 100 pod weight and 100 kernel weight. Similar results were also reported by Chesney (1975), Dahatonde and Rahate (1975) and Saini and Tripathi (1975). Table 18 shows that the levels of P_2O_5 had no effect on shelling percentage. This is in agreement with the findings of Puntamkar and Bathkal (1967) and Saini and Tripathi (1974).

Potassium level of 50 kg K_2O per hectare increased the natural test weight, 100 pod weight and 100 kernel weight which was on par with 75 kg K_2O per hectare. Potassium is essential in the synthesis of simple sugar, starch and proteins and for the formation of oils apart from its role in the normal cell division in plants. These roles of potassium in plants can be attributed to the increase in the natural test weight, 100 pod weight and 100 kernel weight.

TMV-2 was found to be superior to TMV-9 in natural test weight, 100 pod weight, 100 kernel weight and shelling percentage. These differences between the two varieties are due to their varietal character as reported by Muhammed *et al.* (1973), and Purushothaman *et al.* (1974).

C. Quality Factors

1. Protein content of kernel.

The results (Table 19) show that 100 kg P_2O_5 per hectare which recorded a maximum of 27.24 per cent protein was significantly superior to 75 kg P_2O_5 per hectare which in turn was also superior to the protein content at 50 kg P_2O_5 per hectare. The higher levels of phosphorus might have influenced the synthesis of protein in the kernel. Most of the cellular proteins are enzymes that catalyse individual metabolic reactions and phosphorus is a constituent of many of them (Black, 1968). Increases in the protein content of groundnut kernel due to application of phosphorus were reported by Punnoose (1968), Arora et al. (1970), Ozueti and Oyenuga (1970), Kumar and Venkatachari (1971), Muraleedharan (1971) and Bhuiya and Chawdhuri (1974).

Potassium at higher levels was found to decrease the percentage of protein content in kernels. The highest percentage of protein (26.99 per cent) was observed in plots applied with 25 kg K_2O per hectare. This finding corroborate the observations of Nakagawa et al. (1966) and Bhuiya and Chawdhury (1974).

The kernels of TMV-2 had 0.13 per cent higher protein than TMV-9 and this may be a varietal character.

2. Oil content of kernel.

The results (Table 20) reveal that phosphorus had no effect on oil content of groundnut kernel. This is in conformity with the findings of Nijhawan (1962 a) and

Puntamkar and Bathkal (1967).

It may be observed from the results that the highest level (75 kg K_2O per hectare) produced 50.43 per cent oil which was 1.42 per cent more than that of the lowest level. Potassium application enhanced the oil percentage by activating fat producing enzymes (Gupta et al., 1975). Increases in the oil content of groundnut kernels in response to increased potassium application were reported by Hong and Schuylenborgh (1953), Veeraraghavan (1964), Roy and Chatterjee (1972), Habeebulla (1973) and Bhuiya and Chawdhury (1974).

TMV-9 was superior in oil content and produced 2.43 per cent more oil than TMV-2. The difference in oil content between the two varieties may be due to the varietal character as reported by Muhammed et al. (1973) and Anon. (1974).

D. Chemical Composition and Uptake of Nutrients

1. Nitrogen content of haulm, shell and kernel and the total uptake of nitrogen.

Tables 21, 22 and 23 show that the nitrogen contents of haulm, shell and kernel were increased by increasing levels of phosphorus and 100 kg P_2O_5 per hectare had significantly increased the nitrogen contents of plant parts over that of 50 kg P_2O_5 per hectare. In kernel, the level of 75 kg P_2O_5 per hectare also influenced the nitrogen percentage significantly over that of 50 kg P_2O_5 per hectare. The uptake of nitrogen (Table 24) was also increased by higher levels of phosphorus. The increases in the uptake of nitrogen by the increase in P_2O_5 application from 50 to 75 kg and from 75 to 100 kg per hectare were 12.43 and 8.35 kg per hectare respectively. It may be noted from the results that this increase in nitrogen uptake was reflected in both the chemical composition of the plant and the yield. Puntamkar and Bathkal (1967) reported that higher levels of phosphorus increased the nitrogen uptake and concentration of nitrogen in pods as compared to lower levels of phosphorus. Khan (1977) reported that combination of nitrogen and phosphorus increased the nitrogen concentration in plant parts and their total uptake.

Increasing levels of potassium upto 75 kg K_2O per hectare increased the nitrogen content of haulm, but in shell and kernel, the nitrogen content was decreased by the higher levels. Similar results were reported by Puntamkar and Bathkal (1967) and Habeebulla (1973). The total uptake of nitrogen was significantly increased by higher levels of potassium and the highest uptake of 98.50 kg nitrogen was noticed at 75 kg K_2O per hectare. The increase in the total uptake also was reflected in the chemical composition of haulm and the yield.

The nitrogen content of haulm of the variety TMV-9 was found to be higher to that of TMV-2. On the other hand in the kernel, it was higher in TMV-2 than in TMV-9. However, the nitrogen contents of shell of both the varieties were on par. The increase in the nitrogen content found in the kernel of TMV-2 might be due to the enhanced translocation of this element from the leaves to the kernels which is evidenced by a higher protein deposition in TMV-2 as seen in Table 19. The results of this experiment also apparently support the finding of Habeebulla (1973) that increase in oil content was negatively related to protein content of kernel. The total uptake of nitrogen by TMV-9 was higher than that of TMV-2 and this might be due to the higher yields of pod and haulm produced by TMV-9.

2. Phosphorus content of haulm, shell and kernel and the total uptake of phosphorus.

It can be seen from the results (Tables 26 and 27) that higher levels of phosphorus upto 100 kg P_2O_5 per hectare increased the phosphorus content of shell and kernel whereas the increase of phosphorus content in haulm (Table 25) was significant upto 75 kg P_2O_5 only. The highest content of phosphorus was noticed in kernel (0.535 per cent) followed by haulm and shell (0.277 and 0.110 per cent) respectively. The total uptake of phosphorus was significant at higher levels of phosphorus tried.

The present finding is in agreement with that of Puntamkar and Bathkal (1967), Omueti and Oyenuga (1970) and Yadav and Singh (1970).

Potassium levels of 50 kg and 75 kg K_2O per hectare increased the phosphorus content of shell and kernel over that of 25 kg K_2O per hectare. However, the phosphorus content of haulm was unaffected by higher levels of potassium. The total uptake of phosphorus was significantly increased by the higher levels of potassium. Reports of similar nature were made by Puntamkar and Bathkal (1967), Yadav and Singh (1970) and Habeebulla (1973).

The varieties TMV-2 and TMV-9 did not show any difference in phosphorus content of haulm, shell and kernel. However, the total uptake of phosphorus by TMV-9 was found to be higher than that of TMV-2 and this is due to the difference in yield of haulm and pod.

3. <u>Potassium content of haulm, shell and kernel and the total uptake of potassium.</u>

The results given in Tables 29, 30 and 31 show that phosphorus had no significant influence on the potassium content of haulm and kernel. Similar results were reported by Walker *et al*. (1974). However, the potassium content of shell was increased by the level of 75 kg and 100 kg over that of 50 kg P_2O_5 per hectare. The total uptake of potassium was increased by increasing levels of phosphorus upto 75 kg P_2O_5 per hectare. Similar findings were reported earlier by Puntankar and Bathkal (1967) and Omueti and Oyenuga (1970).

Potassium levels upto 75 kg K_2O per hectare increased the potassium content of haulm and shell. The increase of potassium content in kernel by added potassium was significant only upto 50 kg K_2O per hectare.

The total uptake of potassium was significantly increased by both the higher levels over the lower level. Similar findings were reported by Puntamkar and Bathkal (1967), Yadav and Singh (1970), Roy and Chawdhury (1972), Habeebulla (1973), Walker (1973) and Balasundaram (1976).

D. Correlation Studies

In the correlation studies conducted on some of the important observations (Table 33) it was noticed that the yield of pods was positively and significantly correlated to haulm yield, yield attributes and nutrient uptake. Yield of pods and haulms were highly correlated (0.984). Chandramohan <u>et al</u>. (1967) reported similar correlation between haulm yield and pod yield.

Productive attributes like number of pegs formed per plant, number of mature pods per plant and 100 pod weight were positively and significantly correlated with yield of pods. This is in conformity with the findings of Dholaria et al. (1972).

The uptake of nitrogen, phosphorus and potassium and weight of root nodules per plant significantly and positively correlated with yield of pods, number of pegs formed per plant, number of mature pods per plant and hundred pod weight. The positive and significant correlations of these observations show that they were closely linked with the uptake of nitrogen, phosphorus and potassium. Identical results were reported by Habeebulla (1973).

The oil content of kernel was correlated with the uptake of both phosphorus and potassium and the 'r' values (0.540 and 0.587 respectively) were positive and significant. This shows that the oil content was associated with the uptake of these nutrients.

E. Response Curve and Economics of Fertilizer application

The response curve for phosphorus (Fig.7) shows that the optimum and economic doses of phosphorus were 94 and 90 kg P_2O_5 respectively. The rate of increase in yield due to increasing levels of P_2O_5 from 50 to 75 kg and 75 to 100 kg per hectare were 23.64 kg and 5.11 kg pods per kg of P_2O_5 respectively. This indicates that the rate of response was declining with every unit increase in the level of P_2O_5. Similar trends were noted by Puntakmar and Bathkal (1967).

The levels for optimum yield and the economic dose of potassium were 124 kg and 116 kg K_2O respectively as shown in Fig.7. The curve shows that the highest level of potassium (75 kg K_2O per hectare) was inadequate for a good crop of groundnut, under the conditions of the experimental site. The rate of increase of pod for increasing levels of potassium from 25 to 50 kg and from 50 to 75 kg K_2O per hectare were 15.08 and 10.68 kg per one kg increase in applied K_2O respectively. Here also the rate of increase in yield declined for every unit increase of potassium application.

The economics of fertilizer application given in Table 34 shows that the maximum economic returns (Rs.584.28 and Rs.722.47) can be obtained by the application of 90 kg P_2O_5 and 116 kg K_2O per hectare respectively.

The variety TMV-9 was superior to TMV-2 with respect to its increased pod yield (196.9 kg per hectare), besides its desirable qualities like seed dormancy and higher content of oil (50.86 per cent). The same variety gave the maximum profit under the agro-climatic conditions of Vellayani.

SUMMARY

SUMMARY

An investigation was carried out in the red loam soils of Vellayani, Trivandrum, during 1976-77 to study the performances of two groundnut varieties, TMV-2 and TMV-9, under three levels of phosphorus (50, 75 and 100 kg P_2O_5/ha) and three levels of potassium (25, 50 and 75 kg K_2O/ha) in a 2×3^2 factorial experiment, partially confounding PK in replication I and PK^2 in replication II. Various growth characters, yield and yield attributes, quality factors, chemical composition and uptake of macro nutrients were studied.

The results of the experiment are summarised hereunder:-

1. Application of P_2O_5 at 100 kg and K_2O at 50 kg per hectare significantly increased the height of plants and the number of leaves per plant.

2. Significant increases in the weight of root nodules per plant by higher levels of phosphorus were recorded on 30th, 60th and 90th day after sowing.

3. Both phosphorus and potassium at higher levels significantly reduced the number of days taken for flowering. TMV-9 required considerably longer period for reaching first flowering than TMV-2.

4. Phosphorus at 100 kg P_2O_5 and potassium at 75 kg K_2O per hectare markedly increased the number of pegs formed per plant compared to lower levels. TMV-9 produced significantly higher number of pegs than TMV-2.

5. Application of phosphorus upto 75 kg P_2O_5/ha and potassium at 75 kg K_2O/ha had profound effect on increasing the number of pods per plant. TMV-9 was superior to TMV-2 in the production of mature pods per plant.

6. Percentage of pegs developed to mature pods was drastically decreased by the increase in the levels of phosphorus and potassium.

7. Weight of mature pods per plant increased with increases in levels of phosphorus upto 100 kg P_2O_5 per hectare and potassium upto 50 kg K_2O per hectare. A higher weight of pods per plant is recorded by TMV-9 over that of TMV-2.

8. Application of phosphorus at the rate of 75 kg P_2O_5 per hectare significantly increased the yield of pods per hectare. Application of 75 kg K_2O per hectare also had the same effect. Variety TMV-9 was superior to TMV-2 in the yield of pods per hectare.

9. Both phosphorus and potassium upto their highest levels (100 kg P_2O_5 and 75 kg K_2O per hectare) significantly increased the yield of haulm per hectare. TMV-9 produced appreciably higher yield of haulm than TMV-2.

10. The levels of 100 kg P_2O_5/ha and 50 kg K_2O/ha significantly increased the natural test weight, 100 pod weight and 100 kernel weight.

11. The variety TMV-2 had significantly higher shelling percentage over TMV-9.

12. Protein content of kernel was significantly increased by higher levels of phosphorus while it was significantly decreased by higher levels of potassium. TMV-2 recorded higher protein content than TMV-9.

13. Potassium at higher levels significantly increased the oil content of kernel. Phosphorus had no effect on oil content. Oil content was significantly higher in TMV-9 than in TMV-2.

14. Nitrogen content of haulm, shell and kernel were increased by the application of 100 kg P_2O_5/ha over that of the lower levels.

15. Nitrogen uptake by the crop was significantly increased by higher levels of phosphorus upto 100 kg P_2O_5 per hectare and potassium upto 75 kg K_2O per hectare.

TMV-9 removed significantly higher amount of nitrogen than TMV-2.

16. Phosphorus at higher levels increased the 'P' content of shell, kernel and haulm while potassium levels increased 'P' content in shell and kernel only.

17. The uptake of phosphorus was significantly increased by higher levels of both phosphorus and potassium. TMV-9 recorded higher uptake of phosphorus than TMV-2.

18. Potassium levels of 50 and 75 kg K_2O per hectare significantly increased the K content of haulm and shell, while in kernel the increase was not significant for the level above 50 kg K_2O per hectare.

19. Potassium uptake was also significantly increased by 75 kg P_2O_5 and 75 kg K_2O per hectare. The uptake of K_2O by TMV-9 was higher than that of TMV-2.

20. The yield of pods had a positive correlation with yield of haulm, number of pegs formed per plant, number of mature pods per plant, 100 pod weight, uptake of nitrogen, uptake of phosphorus, uptake of potassium and weight of root nodules per plant. Uptake of phosphorus and potassium also had direct relationship with the number of pegs formed per plant, number of mature pods per plant, 100 pod weight and the oil content of kernel.

21. The economic dose and the optimum dose of P_2O_5 were found to be 90 and 94 kg per hectare respectively and for K_2O these levels were 116 kg and 124 kg respectively. The applications of 90 kg P_2O_5/ha and 116 kg K_2O/ha were found to give the highest net profit of Rs.584.23 and Rs.722.47 respectively over their lowest levels.

The results of the present investigation reveal that the variety TMV-9 is a suitable bunch variety of groundnut under the red loam soil conditions of Kerala State.

Future line of work

From this study it is seen that under the soil conditions of Kerala State, groundnut responded favourably to potassium even above the highest level used in the present investigation. Hence further trials with higher levels of potassium have to be undertaken. It is also worthwhile to conduct further investigations with TMV-9, which appeared to be better than TMV-2, to determine the optimum requirements of other nutrients and to develop better cultural practices.

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*Original not seen

APPENDICES

APPENDIX I

Analysis of the soil before starting the experiment

Constituents	Content in soil
Course sand	40.2%
Fine sand	29.4%
Silt	2.5%
Clay	27.1%
Total nitrogen	0.0682%
Total P_2O_5	0.0312%
Available P_2O_5	0.0014%
Total K_2O	0.0492%
Available K_2O	0.0004%
pH	5.2

APPENDIX II

Meteorological data during the crop season

Period	Weather data during the crop season				Deviation from the average for 5 years, 1971-72 to 1975-76			
	Total rain fall mm	Maxi-mum	Mini-mum	R.H %	Rain fall mm	Temperature Maxi-mum	Mini-mum	R.H. %
November								
17-23	238.0	30.0	22.9	89.7	+201.8	-0.4	-0.8	+8.7
24-30	17.0	30.3	23.7	88.0	-18.0	-0.1	+0.9	+3.8
December								
1-7	41.0	30.1	22.9	83.0	+7.4	-0.3	+0.2	+5.9
8-14	3.0	31.1	22.9	76.9	-37.2	+0.3	+0.6	-2.2
15-21	0.0	31.4	23.4	79.4	-42.5	+0.7	+1.4	+0.3
22-28	4.0	31.3	22.6	74.3	-20.1	@0.5	+0.4	+0.5
December 29 to Jan.4	0.0	31.0	22.0	74.4	-16.0	+0.4	+0.7	-3.2
January								
5-11	0.0	31.2	21.9	70.7	- 3.2	+0.6	+0.3	-6.0
12-18	0.0	31.4	20.2	68.7	-7.0	+0.6	-1.8	-8.2
19-25	0.0	31.5	20.9	67.8	-4.0	+0.7	-1.1	-7.1
January 27 to Feb.1	0.0	30.8	22.4	76.7	-12.0	-0.2	+0.2	-0.8
February								
2-8	0.0	31.1	22.9	74.9	-30.0	+0.4	+0.9	+0.3
9-15	0.0	31.4	22.7	78.0	-4.0	+0.7	+0.4	+4.0
16-22	65.0	31.3	23.2	77.3	+49.0	-0.1	+0.7	-3.4
February 23 to March 1	0.0	32.4	23.3	78.0	-52.6	+0.8	+1.2	+1.2
March 2-8	16.0	33.1	24.2	73.6	-22.3	+1.5	+0.8	-3.7
9-15	0.0	32.0	23.7	81.6	-14.0	+0.8	-0.4	+2.9

Positive sign (+) shows increase over the average data and negative sign (-) the decrease.

APPENDIX III

Mean height of groundnut plant at maturity
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	402.71	35		
Block	24.29	5	4.86	1.80
V	10.14	1	10.14	3.76
P	199.15	2	99.58	36.88**
V x P	0.36	2	0.18	0.07
K	120.46	2	60.23	22.31**
V x K	5.09	2	2.55	0.94
PK	6.54	2*	3.27	1.21
PK^2	0.60	2*	0.30	0.11
V x PK	0.62	2	0.31	0.11
V x PK^2	0.19	2	0.10	0.04
Error	35.27	13	2.70	

** Significant at 0.01 level

APPENDIX IV

Mean number of branches per groundnut plant
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	17.86	35		
Block	0.92	5	0.18	0.28
V	1.48	1	1.48	2.28
P	0.77	2	0.39	0.60
V x P	2.18	2	1.09	1.68
K	2.18	2	1.09	1.68
V x K	0.05	2	0.03	0.05
PK	0.36	2*	0.18	0.28
PK^2	0.26	2*	0.13	0.20
V x PK	0.30	2	0.15	0.23
V x PK^2	0.92	2	0.46	0.71
Error	8.44	13	0.65	

APPENDIX V

Mean number of leaves per plant at maturity
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	1376.75	35		
Block	142.58	5	28.52	1.32
V	4.69	1	4.69	0.22
P	353.17	2	176.59	8.16**
V x P	40.06	2	20.03	0.93
K	470.17	2	235.09	10.87**
V x K	8.39	2	4.20	0.19
PK	44.33	2*	22.17	1.02
PK^2	6.33	2*	3.17	0.15
V x PK	24.34	2	12.17	0.56
V x PK^2	1.44	2	0.72	0.03
Error	281.25	13	21.63	

**Significant at 0.01 level

APPENDIX VI

Mean weight of nodular tissue (mg)
1st stage - 30th day after sowing

(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	351.64	35		
Block	73.47	5	14.69	2.03
V	0.70	1	0.70	0.10
P	57.06	2	28.53	3.94*
V x P	22.71	2	11.36	1.57
K	41.72	2	20.86	2.88
V x K	13.72	2	6.86	0.95
PK	8.11	2	4.06	0.56
PK^2	22.11	2	11.06	1.53
V x PK	17.45	2	8.73	1.00
V x PK^2	0.33	2	0.17	0.02
Error	94.26	13	7.25	

*Significant at 0.05 level

APPENDIX VII

Mean weight of nodular tissue (mg)
2nd stage - 60th day after sowing

(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	1264.97	35		
Block	37.80	5	7.56	0.19
V	12.25	1	12.25	0.31
P	439.05	2	219.53	5.62*
V x P	12.17	2	6.09	0.16
K	44.05	2	22.03	0.56
V x K	12.17	2	6.09	0.16
PK	72.45	2*	36.23	0.93
PK^2	53.77	2*	26.89	0.69
V x PK	64.00	2	32.00	0.82
V x PK^2	9.34	2	4.67	0.12
Error	507.92	13	39.07	

*Significant at 0.05 level

APPENDIX VIII

Mean weight of nodular tissue (mg)
3rd stage - 90th day after sowing

(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	304.75	35		
Block	21.92	5	4.38	0.73
V	1.36	1	1.36	0.23
P	150.50	2	75.25	12.54**
V x P	0.39	2	0.20	0.03
K	21.50	2	10.75	1.79
V x K	1.06	2	0.53	0.09
PK	12.11	2*	6.06	1.01
PK^2	8.45	2*	4.23	0.71
V x PK	8.12	2	4.06	0.68
V x PK^2	1.33	2	0.67	0.11
Error	78.01	13	6.00	

** Significant at 0.01 level

APPENDIX IX

Mean number of days taken for flowering
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	25.58	35		
Block	2.63	5	0.53	17.67
V	9.93	1	9.93	331.00**
P	7.40	2	3.70	123.30**
V x P	0.09	2	0.05	1.67
K	2.04	2	1.02	34.00**
V x K	0.32	2	0.16	5.33*
PK	0.67	2*	0.34	11.33**
PK^2	0.55	2*	0.28	9.33**
V x PK	1.42	2	0.71	23.67**
V x PK^2	0.11	2	0.06	2.00
Error	0.42	13	0.03	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX X

Mean number of pegs formed per plant
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	1063.96	35		
Block	4.73	5	0.95	0.70
V	74.24	1	74.24	54.59**
P	793.55	2	396.78	291.75**
V x P	7.16	2	3.58	2.63
K	161.01	2	80.51	59.20**
V x K	0.54	2	0.27	0.20
PK	1.11	2*	0.56	0.41
PK^2	2.65	2*	1.33	0.98
V x PK	1.07	2	0.54	0.40
V x PK^2	0.18	2	0.09	0.70
Error	17.72	13	1.36	

**Significant at 0.01 level

APPENDIX XI

Mean number of mature pods per plant
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	22.23	35		
Block	1.77	5	0.35	1.52
V	5.07	1	5.07	22.04**
P	6.51	2	3.29	14.30**
V x P	0.00	2	0.00	0.00
K	4.36	2	2.24	9.74**
V x K	0.20	2	0.10	0.43
PK	0.07	2*	0.04	0.17
PK^2	0.61	2*	0.31	1.35
V x PK	0.08	2	0.04	0.17
V x PK^2	1.41	2	0.71	3.09
Error	3.00	13	0.23	

**Significant at 0.01 level

APPENDIX XII

Percentage of pegs developed to mature pods
(Analysis of variance)

(After angular transformation)

Source	S.S.	df	M.S.	F
Total	1320.04	35		
Block	21.31	5	4.26	0.84
V	15.36	1	15.36	3.04
P	1032.43	2	516.22	102.22**
V x P	2.76	2	1.38	0.27
K	122.31	2	61.16	12.11**
V x K	10.74	2	5.37	1.06
PK	17.83	2*	8.92	1.77
PK^2	4.76	2*	2.38	0.47
V x PK	3.42	2	1.71	0.34
V x PK^2	23.52	2	11.76	2.33
Error	65.60	13	5.05	

**Significant at 0.01 level

APPENDIX XIII

Mean weight of mature pods per plant
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	22.49	35		
Block	3.09	5	0.62	6.2
V	3.37	1	3.37	33.7**
P	7.19	2	3.60	36.0**
V x P	0.01	2	0.01	0.1
K	5.44	2	2.72	27.2**
V x K	0.07	2	0.04	0.4
PK	0.78	2*	0.39	3.9*
PK^2	0.92	2*	0.46	4.6*
V x PK	0.11	2	0.06	0.6
V x PK^2	0.20	2	0.10	1.0
Error	1.31	13	0.10	

*Significant at 0.05 level
**Significant at 0.05 level

APPENDIX XIV

Yield of pods (kg/plot)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	10.62	35		
Block	1.68	5	0.34	5.67*
V	1.97	1	1.97	32.83**
P	3.20	2	1.60	26.67**
V x P	0.10	2	0.05	0.83
K	2.28	2	1.14	19.00**
V x K	0.06	2	0.03	0.50
PK	0.03	2*	0.02	0.33
PK^2	0.49	2*	0.25	4.17*
V x PK	0.05	2	0.03	0.50
V x PK^2	0.04	2	0.02	0.33
Error	0.72	13	0.06	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XV

Yield of haulm (kg/plot)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	84.81	35		
Block	10.53	5	2.11	5.55*
V	15.98	1	15.98	42.05**
P	23.11	2	11.56	30.42**
V x P	0.76	2	0.38	1.00
K	25.60	2	12.80	33.68**
V x K	0.58	2	0.29	0.76
PK	0.16	2*	0.08	0.21
PK^2	2.83	2*	1.42	3.74
V x PK	0.24	2	0.12	0.32
V x PK^2	0.13	2	0.07	0.18
Error	4.89	13	0.38	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XVI

Percentage of two seeded pods
(After angular transformation)

(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	612.52	35		
Block	104.46	5	20.89	1.33
V	20.19	1	20.19	1.28
P	18.26	2	9.13	0.58
V x P	19.76	2	9.88	0.63
K	73.42	2	36.71	2.33
V x K	3.98	2	1.99	1.33
PK	6.60	2*	3.30	2.10
PK^2	41.51	2*	20.76	1.32
V x PK	60.90	2	30.45	1.93
V x PK^2	22.85	2	11.43	0.73
Error	204.59	13	15.74	

APPENDIX XVII

Natural test weight of pods in g/litre
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	10287.22	35		
Block	2050.89	5	530.18	6.66*
V	693.44	1	693.44	8.71**
P	1036.22	2	518.11	6.51*
V x P	124.23	2	62.12	0.78
K	3045.72	2	1522.86	19.14**
V x K	368.39	2	184.20	2.31
PK	274.56	2*	137.28	1.73
PK^2	685.78	2*	342.89	4.31*
V x PK	361.49	2	180.75	2.27
V x PK^2	12.00	2	6.00	0.08
Error	1034.50	13	79.58	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XVIII

Mean weight of 100 pods
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	32.42	35		
Block	1.86	5	0.37	0.90
V	1.11	1	1.11	2.71
P	12.31	2	6.16	15.02**
V x P	0.00	2	0.00	0.00
K	8.91	2	4.46	10.88**
V x K	0.52	2	0.26	0.63
PK	0.52	2*	0.26	0.63
PK^2	0.30	2*	0.15	0.37
V x PK	1.55	2	0.78	1.90
V x PK^2	0.03	2	0.02	0.05
Error	5.31	13	0.41	

**Significant at 0.01 level

APPENDIX XIX

Mean weight of 100 kernels (g)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	56.14	35		
Block	3.39	5	0.68	1.42
V	2.78	1	2.78	5.79*
P	19.02	2	9.51	19.81**
V x P	0.59	2	0.30	0.63
K	19.06	2	9.53	19.85**
V x K	0.05	2	0.03	0.06
PK	0.58	2*	0.29	0.60
PK^2	3.70	2*	1.85	3.85*
V x PK	0.19	2	0.10	0.21
V x PK^2	0.57	2	0.29	0.60
Error	6.21	13	0.48	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XX

Shelling percentage
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	53.50	35		
Block	3.67	5	1.73	1.27
V	7.11	1	7.11	5.23*
P	6.79	2	3.40	2.50
V x P	0.52	2	0.26	0.19
K	5.54	2	2.77	2.04
V x K	2.10	2	1.05	0.77
PK	1.08	2*	0.54	0.40
PK^2	2.58	2*	1.29	0.95
V x PK	3.09	2	1.55	1.14
V x PK^2	0.36	2	0.18	0.13
Error	17.66	13	1.36	

*Significant at 0.05 level

APPENDIX XXI

Protein content in kernel (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	7.89	35		
Block	0.14	5	0.03	1.50
V	0.16	1	0.16	8.00*
P	5.33	2	2.67	133.50**
V x P	0.13	2	0.07	3.50
K	1.60	2	0.80	40.00**
V x K	0.03	2	0.02	1.00
PK	0.08	2*	0.04	2.00
PK^2	0.04	2*	0.02	1.00
V x PK	0.12	2	0.06	3.00
V x PK^2	0.05	2	0.03	1.50
Error	0.21	13	0.02	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXII

Oil content in kernels (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	79.79	35		
Block	2.62	5	0.52	2.36
V	53.29	1	53.29	242.23**
P	0.27	2	0.14	0.64
V x P	0.07	2	0.04	0.18
K	12.42	2	6.21	28.23**
V x K	0.50	2	0.25	1.14
PK	0.13	2*	0.07	0.32
PK^2	0.13	2*	0.07	0.32
V x PK	1.23	2	0.62	2.82
V x PK^2	0.30	2	0.15	0.68
Error	2.83	13	0.22	

**Significant at 0.01 level

APPENDIX XXIII

Nitrogen content in haulm (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.6811	35		
Block	0.0080	5	0.0016	0.62
V	0.0152	1	0.0152	5.89*
P	0.4919	2	0.2459	95.33**
V x P	0.0002	2	0.0001	0.04
K	0.1036	2	0.0518	20.08**
V x K	0.0068	2	0.0034	1.32
PK	0.0035	2*	0.0017	0.68
PK^2	0.0029	2*	0.0014	0.56
V x PK	0.0007	2	0.0003	0.13
V x PK^2	0.0147	2	0.0073	2.85
Error	0.0336	13	0.0026	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXIV

Nitrogen content in shell (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.0382	35		
Block	0.0014	5	0.0003	1.00
V	0.0001	1	0.0001	0.33
P	0.0258	2	0.0129	43.00**
V x P	0.0000	2	0.0000	0.00
K	0.0061	2	0.0031	10.33**
V x K	0.0000	2	0.0000	0.00
PK	0.0001	2*	0.0001	0.33
PK^2	0.0003	2*	0.0002	0.67
V x PK	0.0003	2	0.0002	0.67
V x PK^2	0.0002	2	0.0001	0.33
Error	0.0039	13	0.0003	

**Significant at 0.01 level

APPENDIX XXV

Nitrogen content in kernels (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.2027	35		
Block	0.0036	5	0.0007	1.40
V	0.0041	1	0.0041	8.20*
P	0.1369	2	0.0685	137.00**
V x P	0.0030	2	0.0015	3.00
K	0.0409	2	0.0205	41.00**
V x K	0.0008	2	0.0004	0.80
PK	0.0021	2*	0.0011	2.20
PK^2	0.0010	2*	0.0005	1.00
V x PK	0.0031	2	0.0016	3.20
V x PK^2	0.0015	2	0.0008	1.60
Error	0.0059	13	0.0005	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXVI

Uptake of nitrogen (kg/ha)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	5798.37	35		
Block	733.61	5	146.72	5.23*
V	521.51	1	521.51	18.59**
P	2623.50	2	1311.75	46.75**
V x P	38.03	2	19.02	0.68
K	1276.46	2	638.23	22.75**
V x K	21.43	2	10.72	0.38
PK	6.47	2*	3.24	0.12
PK^2	174.35	2*	87.18	3.11
V x PK	35.07	2	17.54	0.63
V x PK^2	3.13	2	1.57	0.06
Error	364.81	13	28.06	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXVII

Phosphorus content of haulm (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.01856	35		
Block	0.00266	5	0.00053	1.47
V	0.00135	1	0.00135	3.75
P	0.00514	2	0.00257	7.14**
V x P	0.00037	2	0.00019	0.52
K	0.00051	2	0.00026	0.72
V x K	0.00060	2	0.00030	0.83
PK	0.00054	2*	0.00027	0.75
PK^2	0.00154	2*	0.00077	2.14
V x PK	0.00023	2	0.00012	0.33
V x PK^2	0.00089	2	0.00045	1.25
Error	0.00473	13	0.00036	

**Significant at 0.01 level

APPENDIX XXVIII

Phosphorus content of shell (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.0055	35		
Block	0.0005	5	0.0001	1.0
V	0.0000	1	0.0000	0.0
P	0.0022	2	0.0011	11.0**
V x P	0.0000	2	0.0000	0.0
K	0.0014	2	0.0007	7.0**
V x K	0.0002	2	0.0001	1.0
PK	0.0002	2*	0.0001	1.0
PK^2	0.0000	2*	0.0000	0.0
V x PK	0.0002	2	0.0001	1.0
V x PK^2	0.0001	2	0.0001	1.0
Error	0.0007	13	0.0001	

**Significant at 0.01 level

APPENDIX XXIX

Phosphorus content of kernel (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.02510	35		
Block	0.00357	5	0.00071	3.38*
V	0.00028	1	0.00028	1.33
P	0.00827	2	0.00414	19.71**
V x P	0.00062	2	0.00031	1.48
K	0.00560	2	0.00280	13.33**
V x K	0.00035	2	0.00018	0.86
PK	0.00071	2*	0.00036	1.71
PK^2	0.00031	2*	0.00016	0.76
V x PK	0.00053	2	0.00027	1.29
V x PK^2	0.00218	2	0.00109	5.19*
Error	0.00268	13	0.00021	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXX

Uptake of phosphorus
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	122.81	35		
Block	8.67	5	1.73	2.73
V	11.62	1	11.62	18.33**
P	52.99	2	26.50	41.80**
V x P	0.31	2	0.16	0.25
K	32.57	2	16.29	25.69**
V x K	0.09	2	0.05	0.08
PK	0.64	2*	0.32	0.50
PK^2	5.77	2*	2.89	4.56*
V x PK	0.89	2	0.45	0.71
V x PK^2	1.02	2	0.51	0.80
Error	8.24	13	0.63	

*Significant at 0.05 level
**Significant at 0.01 level

APPENDIX XXXI

Potassium content of haulm (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	6.28	35		
Block	0.45	5	0.09	2.25
V	0.13	1	0.13	3.25
P	0.10	2	0.05	1.25
V x P	0.01	2	0.01	0.25
K	4.95	2	2.48	62.00**
V x K	0.00	2	0.00	0.00
PK	0.01	2*	0.01	0.25
PK^2	0.03	2*	0.02	0.50
V x PK	0.04	2	0.02	0.50
V x PK^2	0.02	2	0.01	0.25
Error	0.54	13	0.04	

**Significant at 0.01 level

APPENDIX XXXII

Potassium content in shell (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.9164	35		
Block	0.0581	5	0.0116	1.78
V	0.0225	1	0.0225	3.46
P	0.1689	2	0.0845	13.00**
V x P	0.0067	2	0.0034	0.52
K	0.5106	2	0.2553	39.28**
V x K	0.0016	2	0.0008	0.12
PK	0.0233	2*	0.0117	1.80
PK^2	0.0077	2*	0.0039	0.60
V x PK	0.0211	2	0.0106	1.63
V x PK^2	0.0112	2	0.0056	0.86
Error	0.0847	13	0.0065	

**Significant at 0.01 level

APPENDIX XXXIII

Potassium content in kernel (percentage)
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	0.476	35		
Block	0.089	5	0.018	2.57
V	0.005	1	0.005	0.71
P	0.044	2	0.022	3.14
V x P	0.004	2	0.002	0.29
K	0.228	2	0.114	16.29**
V x K	0.005	2	0.002	0.29
PK	0.001	2*	0.001	0.14
PK^2	0.001	2*	0.001	0.14
V x PK	0.003	2	0.002	0.29
V x PK^2	0.010	2	0.005	0.71
Error	0.088	13	0.007	

**Significant at 0.01 level

APPENDIX XXXIV

Uptake of potassium
(Analysis of variance)

Source	S.S.	df	M.S.	F
Total	6195.49	35		
Block	340.99	5	68.20	2.62
V	337.34	1	337.34	12.94**
P	1014.34	2	507.17	19.46**
V x P	26.33	2	13.17	0.51
K	3981.95	2	1990.93	76.40**
V x K	8.20	2	4.10	0.16
PK	9.41	2*	4.77	0.18
PK^2	104.06	2*	52.03	2.00
V x PK	23.16	2	11.58	0.44
V x PK^2	10.94	2	5.47	0.21
Error	338.77	13	26.06	

**Significant at 0.01 level

STUDIES ON THE PERFORMANCE OF TWO GROUNDNUT VARIETIES, TMV-2 AND TMV-9, UNDER GRADED DOSES OF PHOSPHORUS AND POTASSIUM

N. PURUSHOTHAMAN NAIR

ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree

MASTER OF SCIENCE IN AGRICULTURE

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ABSTRACT

An investigation was carried out at the Instructional Farm, College of Agriculture, Vellayani during 1976-77 to study the comparative performance of two varieties of groundnut, TMV-2 and TMV-9, under three levels of phosphorus (50, 75 and 100 kg P_2O_5/ha) and three levels of potassium (25, 50 and 75 kg K_2O per hectare) in a 2 x 3^2 factorial experiment with two replications, partially confounding PK in replication I and PK^2 in replication II.

Phosphorus at 100 kg P_2O_5 per hectare increased the height of plants, number of leaves per plant and mean weight of root nodules per plant. Potassium level of 50 kg K_2O per hectare also increased the mean height of plants and number of leaves per plant. TMV-2 and TMV-9 were found similar in these characters.

Higher levels of phosphorus and potassium increased the number of pegs formed per plant, number of mature pods per plant, weight of mature pods per plant, yield of pods and yield of haulm per hectare, natural test weight, 100 pod weight and 100 kernel weight.

TMV-9 was superior to TMV-2 in the number of pegs formed per plant, number and weight of mature pods per plant, and yields of pods and haulm per hectare. The natural

test weight, 100 kernel weight and shelling percentage were higher in TMV-2 than variety TMV-9.

Both phosphorus and potassium at higher levels decreased the number of days taken for flowering and the percentage of pegs developed to mature pods. TMV-2 flowered earlier than TMV-9.

Protein content of kernel was increased by higher levels of phosphorus, while higher levels of potassium decreased it. Potassium at higher levels increased the oil content of kernel. The variety TMV-9 had lower protein content and higher oil content over those of TMV-2.

The uptake of nitrogen, phosphorus and potassium were increased by higher levels of phosphorus and potassium fertilisation. The removal of these nutrients were higher by variety TMV-9 than by TMV-2.

Correlation studies revealed that yield of pods was positively correlated to yield of haulm, number of pegs formed per plant and the uptake of nitrogen, phosphorus and potassium.

The optimum and economic levels of phosphorus and potassium were 94 and 90 kg P_2O_5 per hectare and 124 and 116 kg K_2O per hectare respectively. From the economics of fertilizer application it was found that the highest net profits of Rs.584.28 and Rs.722.47 could be obtained by 90 kg P_2O_5 and 116 kg K_2O per hectare respectively.