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Research Article

Effect of Nutrient Management and Planting Systems on Physiological and Biochemical Parameters of Banana cv. Ney Poovan under Coconut Plantation

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Abstract
The field experiment was conducted at the Department of Fruit Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to study the effect of nutrient management and planting systems on physiological and biochemical parameters in banana cv. Ney Poovan under coconut plantation. The experiment was laid out in a Factorial Randomized Block Design with nine treatments and three replications. The recommended spacing of 1.8 m x 1.8 m was adopted for planting. Suckers of banana cv. Ney Poovan collected from the disease free field was used for planting. Suckers of uniform size weighing around 1.5 kg $\pm$ 0.5 kg of banana cv. Ney Poovan were selected for planting. Recommended crop production packages for banana were followed. The recommended dose of fertilizer (RDF) for banana cv. Ney Poovan is 110g: 35g: 330g NPK plant^{-1} year^{-1}was applied as per the treatment schedule. Ten plants of uniform size were selected at random in each treatment for recording the following observations on vegetative characters at 3rd, 5th, 7thmonths after planting and shooting stage. The yield and quality attributes were taken after the harvesting of bunches. The biofertilizers was applied to the plant twice, one at the time of planting and another at 60days after planting. Application of inorganic fertilizers as per the treatment schedule was applied at the time of planting, 3rd months after planting, 5th months after planting, 7th months after planting and shooting stage at different split doses.The results of the present investigation revealed that integrated nutrient management and planting density was enhanced the physiological and biochemical attributes of banana by application of 100 per cent RDF along with *Azospirillum*@100g plant^{-1}, phosphobacteria @ 100 g plant^{-1} and AM fungi @ 100g plant^{-1} in single row planting system. The total chlorophyll content of leaves was highest in $F_6 P_1$ (2.52 & 2.54 mg 100 g^{-1}) in both the season of crops. Other physiological parameters *viz.,* light interception, transpiration rate, net photosynthesis, stomatal conductance and soluble protein content, nitrate reductase activity were also recorded as the highest in the same treatment.

Keywords: *Planting Systems, Coconut Plantation, and nutrient management.*

Introduction

Banana cv. Ney Poovan is the choicest diploid (AB) cultivar (Syn: Kadali, Elakki bale, Njali Poovan) which is under commercial cultivation on a large scale especially in Karnataka and Tamil Nadu. Banana (*Musa sp.*) is the second largest fruit crop grown in the world. In India, it is one of the most important commercial fruits which contain more carbohydrate and energy. Therefore it is mostly used in raw and cooked form. Banana is originated from South East Asia, a region considered as the primary centre of diversification of the crop and where earlier domestication has occurred (Simmonds, 1966). Bananas and plantain are mostly grown not only for their nutritional value but also for

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their economic importance. Banana fruit is highly nutritious, easily digestible than many other fruits and it is popular for its aroma and texture. Besides, it is rich in K, Ca, low in Na and Fe content. It is an ideal food for weaning infant mother. The demand for banana is increasing day by day due to its nutritional value and high economic return realized by the farmers.

Coconut being widely spaced owing to its morphological features provide ample opportunities for cropping in the interspaces. Sahasranamam and Pillai (1976) observed that only 23 per cent of the soil on area basis is effectively utilised by the coconut roots in a coconut plantation planted at 7.5 m spacing. The effective root zone of an adult bearing palm growing under normal management is confined laterally within a radius of 2 m around the base of the palm. About 74 per cent of roots do not extend beyond this distance. On depth basis, the top 30 cm layer is practically devoid of functional roots and 80 per cent of the roots are found between 30 cm and 120 cm depth from surface. It was further confirmed that more than 80 per cent of the root activity was confined to a lateral distance of 2m from the trunk. This shows that on an area basis of total available land in a pure palm stand is not effectively utilized by coconut roots and can support many more crops. Thus, the active root zone of coconut is confined to 25 per cent of the available land area and the remaining area could be profitably exploited for raising subsidiary crops (Reddy and Biddappa, 2000)

Coconut based cropping systems involving cultivation of compatible crops in the interspaces of coconut offer considerable scope for increasing productivity unit area^{-1}, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour (Bavappa and Jacob, 1982). Hence, the interspaces of coconut plantation can very well be utilized by introducing profitable fruit crops like banana, pineapple and acid lime. Introduction of banana as a suitable intercrop under coconut shade is practiced by the small and marginal coconut farmers in tropical countries. Moreover, many earlier studies showed that banana cultivars are found to be shade tolerant. Further, it was clearly indicated that banana cultivation as suitable intercrops under coconut plantation was highly productive and profitable.

Application of bioinoculants containing beneficial microorganisms instead of inorganic fertilizers are known to improve plant growth through the supply of needy plant nutrients and may help to sustain soil health and environment. The plant growth promoting rhizobacteria such as*Azospirillum*, *Bacillus subtilis* and *Pseudomonas fluorescens* as biofertilizers are able to enhance the crop growth and yield through direct and indirect mechanisms. *Azospirillum* has a direct role on biological nitrogen fixation, which contributes nitrogen requirement of plant and also by production of growth hormones which alter plant metabolism and growth. General improvement in the growth of the entire root system, resulting in enhanced mineral and water uptake and nitrate reductase activity in roots, which increases nitrate accumulation in inoculated plants. Usage of AM fungi is a good strategy for promoting the growth of banana plants by improved water and nutrient absorption. It is well documented that AM fungi symbiosis can increase plant growth and nutrient uptake ability of plant roots, reduce access sites of root invading pathogens, stimulate host defence and changes in the microbial composition in the rhizosphere zone.

Among the nutrients, nitrogen is the most essential element and has a positive influence on plant growth, flowering and productivity in banana cultivars (Mustaffa and Kumar, 2012). Though the requirement of phosphorous is low, it helps to produce healthy rhizome, strong root system and prevents lodging. It also plays a vital role in overall development of the plant and flower set. The plant can store phosphorus longer and can utilize it for fruit production and development. Another element of high importance for growth of banana is potassium (Lopez and Espinosa, 1998). It is commonly known as quality mineral nutrient and its requirement is very high during the flowering period. Its concentration in the plant system is much higher than all other nutrients or even all the mineral nutrients combined. Supply of potassium fertilizers in adequate quantity not only increases growth and yield in banana but also governs the physiology of the plant and offers resistance against biotic and abiotic stresses (Mustaffa and Kumar, 2012). It is also known for stimulating early shooting, increasing number of hands, finger size, quality and sweetness apart from increasing the keeping quality and reducing the total water uptake. Hence, the fertilizer application should contain more of potassium and nitrogen (Santos dos. *et al.,* 2009). In general, the input use efficiency of various nutrients used for crop growth and development is currently very low leading to problems of decreased productivity, degradation of soil health and increased environmental pollution apart from the wastage of substantial quantity of the costly and scarce inputs. Increasing the efficiency of water and nutrients will go a long way in realizing the growing demand for food and other plant products (Solaimalai. *et al*., 2005).

Majority of the earlier findings revealed that banana cultivars were found to be location specific. The performance of banana cv. Ney Poovan on planting systems and nutrient management under coconut shade have not been well studied so far. Therefore, the present investigation was carried out to assess the effect of nutrient management and planting systems on physiological and biochemical parameters in banana cv. Ney Poovan under coconut plantation with following objectives.

- To study the influence of planting density and nutrient management on growth, development physiology of banana cv. Ney Poovan under coconut shade.
- To investigate various physiological and biochemical parameters related to the SPAC (Soil Plant Atmospheric Continuum) under coconut shade.

Materials and Methods

The present investigation on the effect of nutrient management and planting systems on physiological and biochemical parameters in banana cv. Ney Poovan under coconut plantation was carried out at the Department of Fruit Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Uniform sized suckers weighing around 1.5 kg $\pm$ 0.5 kg of banana cv. Ney Poovan were selected for planting. Studies were taken up on banana cv. Ney Poovan with two sets of experiment. The field experiment was conducted to assess effect of nutrient management and planting systems on physiological and biochemical parameters in banana cv. Ney Poovan under coconut plantation carried out with two factors. Factor I is nutrient management practices and factor II is planting systems. The experiment was laid out in a Factorial Randomized Block Design with nine treatments and three replications. Each treatment had a plot area of 160 M^2 accommodating 48 plants. Guard rows were provided on all sides of the plots. Observations were taken up from centrally located ten plants. The recommended spacing of 1.8 m x 1.8 m was adopted for planting. Suckers of banana cv. Ney Poovan obtained from disease free field were planted in all the treatments. Recommended cultural practices were carried out regularly. Inorganic fertilizers and biofertilizers were applied as per the treatment schedule. Suckers of uniform size weighing around 1.5 kg $\pm$ 0.5 kg of banana cv. Ney Poovan were selected for planting. Recommended crop production packages for banana were followed. The present experiment consist of various treatments are as follows $F_1 P_1$ (75 per cent RDF in single row planting system), $F_2 P_1$ (100 per cent RDF in single row planting system), $F_3 P_1$ (125 per cent RDF in single row planting system), $F_4 P_1$ (150 per cent RDF in single row planting system), $F_5 P_1$ (75 per cent RDF+ *Azospirillum* @ 100g plant^{-1} + phosphobacteria @100g plant^{-1} + AM fungi @ 100g plant^{-1} in single row planting system), $F_6 P_1$ (100 per cent RDF + *Azospirillum* @100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi

@ 100g plant^{-1} in single row planting system), F_7 P_1 (125 per cent RDF + *Azospirllum* @ 100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi @ 100g plant^{-1} in single row planting system), F_8 P_1 (150 per cent RDF + *Azospirillum* @100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi @ 100g plant^{-1} in single row planting system), F_9 P_1 (single row planting with out nutrients) and F_1 P_2 (75 per cent RDF in double row planting system), F_2 P_2 (100 per cent RDF in double row planting system), F_3 P_2 (125 per cent RDF in double row planting system), F_4 P_2 (150 per cent RDF in double row planting system), F_5 P_2 (75 per cent RDF+ *Azospirllum* @ 100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi @ 100g plant^{-1} in double row planting system), F_6P_2 (100 per cent RDF + *Azospirillum* @ 100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi @ 100g plant^{-1} in double row planting system), F_7 P_2 (125 per cent RDF + *Azospirllum* @ 100g plant^{-1} + phosphobacteria @ 100g plant^{-1} + AM fungi @ 100g plant^{-1} in double row planting system), F_8 P_2 (150 per cent RDF + *Azospirillum* @ 100g plant^{-1} + phosphobacteria @100g plant^{-1} + AM fungi @ 100g plant^{-1} in double row planting system), F_9 P_2 (Double row planting without nutrients). The Recommended Dose of Fertilizer (RDF) for banana cv. Ney Poovan (TNAU Recommendation) is 110 g : 35 g : 330 g NPK plant^{-1} year^{-1} was applied as per the treatment schedule.. The biofertilizers was applied to the plant twice, one at the time of planting and another at 60 days after planting. Application of inorganic fertilizers as per the treatment schedule was applied at the time of planting, 3rd months after planting, 5th months after planting, 7th months after planting and shooting stage at different split doses. Ten plants of uniform size were selected at random in each treatment for recording the observations. The physiological and biochemical attributes *viz.,* Leaf area index (LAI), chlorophyll content, light interception rate, Transpiration rate, Net photosynthesis (Pn). Stomatal conductance (gs**),** photosynthetic rate, soluble protein content, nitrate reductase activity were recorded and the statistical scrutiny of data was done by adopting the standard procedures suggested by Panse and Sukhatme (1976).The level of significance was expressed at 0.05 probability level. The interpretation of the data was done at the critical difference of 0.05 probabilities.

Results and Discussion

Interspace in coconut plantation can be effectively utilized by planting banana as an intercrop. This kind of intercropping system under coconut efficiently use the ground space without competing for water and nutrients since the coconut root system is restricted to 90-100 cm and aerial space is also utilized for sunlight harvest to enhance the photosynthetic efficiency of banana. Hence, this present research work was undertaken to find out the effect of nutrient management and planting systems on physiological and biochemical parameters of banana cv. Ney Poovan under coconut plantation.

Any crop management practice should aim in keeping the physiological processes of the plants in an active condition so that these plants can produce more biomass with least destructive processes. Physiological parameters indicated that the efficiency of the plant expressed in terms of yield. The vigorous growth during all the growth stages of banana is resultant of physiological parameters. Higher photosynthetic activity is a good indication of physiologically efficient plants in banana. Chlorophyll is an essential component for photosynthesis and occurs in chloroplasts as green pigments. The photosynthetic efficiency is a good indication of physiologically active plants. This primarily depends upon the leaf chlorophyll content. The chlorophyll content in leaves indicates the efficiency of photosynthesis where the solar energy is converted into chemical energy. In the current study, the chlorophyll *a, b* and total chlorophyll content estimated at various stages from 3 MAP to harvest in both the seasons, indicated that the treatment combination of F_6 P_1 (100 per cent RDF along with *Azospirillum* @100gplant^{-1}, Phosphobacteria @100g plant^{-1} and AM fungi @100g plant^{-1} in a single row planting) resulted in higher contents of total chlorophyll in both the seasons (Figure. 1 &2).

The chlorophyll content played a vital role in augmenting the available light for photosynthetic function. The higher chlorophyll content in leaves improves the transfer of radiation energy into primary chemical energy in the form of ATP and NADPH in the chloroplasts. Further, these enzymes not only involved in the chlorophyll synthesis but also capable of scavenging the free radicals produced in the plant system and improve the general health of the plants.

This suggests that the plants in the treatment combination F_6 P_1 were more efficient in maintaining a better photosynthetic efficiency responsible to maintain a better physiological status of the plant. The applied nitrogen, phosphorus and potassium were utilized efficiently by the plant, which resulted in producing maximum photosynthates in terms of high biomass and translocating the assimilated materials to the developing sink resulting in heavier bunch weight. The role of nitrogen and potassium in the functioning of chlorophyll is well established. The results are in line with the findings of (Mia. *et al.*, 2010 and Senthil, k. *et al*., 2014) in banana cv. Robusta. (Senthil kumar. *et al*., 2014) who also reported that increased respiratory losses from the mycorrhizal symbiont, AM fungi may function as metabolic sink causing basipetal mobilization of photosynthates to roots thus providing stimulus for greater photosynthetic activity. Increase of plant growth hormones especially cytokinin could alleviate photosynthetic rate by stomatal opening (Incoll and Whitelam, 1977) influencing Iron transport and regulating chlorophyll levels (Richmond and Lang, 1976). Addition of AM fungi improves the photosynthetic CO_2 fixation, which was consistent with increase in chlorophyll and RUB lase activity in sour orange (Nemec and V, 1990). This was in conformity with (Mia. *et al*., 2010) who observed that the inoculation of PGPR bacteria significantly increased plant height, leaf area, leaf chlorophyll content and total dry matter in biofertilizers applied plants compared to uninoculated plants in banana. (Sarig. *et al*., 1988) further suggested that the incorporation of PGPR results in growth promoting effects mainly derived from morphological and physiological changes in roots and enhancement in water and plant nutrient uptake.

Light intensity is the function of lamp wattage and distance from the plant canopy. Light is one of the determining factors in the process of growth and development of banana. In the present experiment, the observation made under coconut based cropping system on the incident light is partly reflected, absorbed and transmitted by the banana canopy.

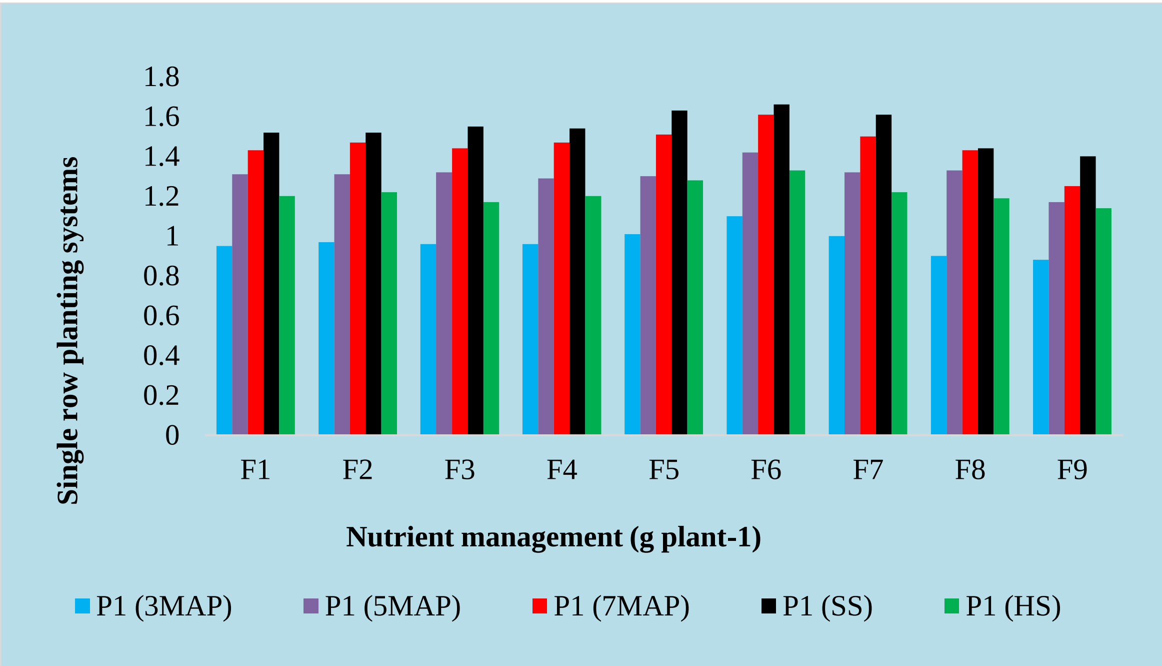
High light accompanied with warm temperature humid moving air might lower leaf temperature and reduce transpiration in banana. The dimension of quantity, growth, direction and periodicity of the light environment on banana canopy would change the growth and development. The higher light interception was recorded in the treatment F_6 P_1 from 3 MAP to shooting stage during both the seasons (Figure. 3 & 4).The light is the most important variable which influenced the short term periodic functions of metabolism and the long term ones of vegetative growth and flowering may be due to the duration and intensity. The influence of light observed to be a critical factor with respect to flowering than vegetative growth. The moisture availability and light intensity were reported to be responsible for the positioning of banana in different vertical levels in the aerial environment under coconut based cropping systems. Light intensity has emerged as the single most influential photo effect in the tropics under partial to full sun light, while grown under varying levels of shade. Reduction in light intensity caused reduced leaf area, leaf elongation, lateral shoot production, root development, dry matter production, sugar content and nitrogen absorption. High light substantially increased total dry weight, sugar, nitrogen absorption with lower nitrogen, the differential carbon assimilation and nitrogen uptake resulted in larger plants. Allowing higher light is helpful to check vegetative growth and favor flowering. The interception and distribution of photo synthetically active radiation within the crop canopy in these shade levels would also affect net photosynthesis. Photosynthetic basis for increasing harvested yield involved light interception and conversion by foliage into photosynthetic products and then the partitioning of photo assimilates to the harvested economic sinks.

The rate of transpiration was also found to be significantly higher with the treatment F_6 P_1 (Figure. 5 & 6) in both the seasons, highlighting the ideal mass flow situation prevailing for enhanced uptake of nutrients for better physiological activity of the plant. Among the nutrients, potassium exerts a role of general metabolic activator by increasing the transpiration rate. It has a major role in stomatal aperture opening and closing. At very low or inadequate potassium levels, the stomata closes earlier during the morning, especially when there is no shade, finally it will affect the production of photosynthetic rate (Martin-Prevel, 1982).

The photosynthetic rate is interrelated with variation in total chlorophyll content, maximum Rubisco activity and photosynthetic capacity. Light response curves of basal and apical portions of leaves showed higher photosynthetic capacity. Shade intensity might be optimum in harnessing more photo synthetically active radiation and maintenance of conducive leaf relative humidity and leaf temperature prevalence might contribute for the better photosynthesis in these treatments.

Net photosynthetic rate is the most important physiological activity in a plant, which when observed in the present investigation showed that the plants application of 100 per cent RDF along with *Azospirillum* @ 100g plant^{-1}, phosphobacteria @ 100 g plant^{-1} and AM fungi @ 100 g plant^{-1} in a single row planting system (F_6 P_1) had the maximum net photosynthetic rate in both the seasons (Figure. 7 & 8). This indicates the active role of microbes in substituting the required nutrients to the plants, there by the plants applied with consortium of biofertilizer have differed significantly in fixation of Photosynthesis. This also showed that the applied nitrogen, phosphorus and potassium were utilized efficiently by the plants which resulted in producing maximum photosynthesis (Nalina. *et al.*, 2009) in the plants. The higher nitrogen incorporation by bacterial N_2 fixation of PGPR might also have apparently increased the formation of protein and enzyme for better physiological activities. The higher nitrogen also might have contributed to the formation of chlorophyll which consequently, increased the photosynthetic activity. This indicates that the plants are physiologically active in exhibiting maximum photosynthetic rate, which may be due to the integration of higher rates of stomatal conductance and transpiration rate (Mahalakshmi, 2000).This justified that the shade intensity that was optimum in these treatments and the stomatal conductance (Figure. 9 & 10) and transpiration rate would strike balance in achieving good growth. During stress periods, the stomatal aperture was shrunken more because of the severe loss in turgidity, leaf temperature and diurnal rhythm of CAM activity of the banana. The increase in osmotic concentration in the guard cells during the process of opening is influenced by the shade. The uptake of K^+ was the light induced phenomenon. The internal resistance of hypostomatous leaves may be increased due to more tortuous intercellular pathways caused by shrinkage. The internal resistance depends on thickness of the leaf and compactness of mesophyll cells and the geometry of the intercellular spaces. The stomatal closure under low water potential may be the main cause for decrease in the transpiration rate during stress periods. This present result is negative with the findings of (Shivashankara. *et al.,* 2001) who observed that tissue cultured plants of Robusta had significantly higher photosynthetic rate and stomatal conductance compared to suckers.

Nitrate reductase activity estimation is related to nitrogen assimilation efficiency of the plant and ultimately the productivity of plants. The assimilatory reduction of nitrate by plants into ammonia, which is further converted into amino acids and various nitrogenous products such as protein is catalyzed by the nitrate reductase enzyme. In the present investigation, nitrate reductase activity and soluble protein estimated at different stages of growth in first season revealed that the treatment $F_6 P_1$ (100 per cent RDF along with *Azospirillum* @ 100 g plant^{-1} ,phosphobacteria @ 100 g plant^{-1} and AM fungi @ 100 g plant^{-1} in a single row planting system) resulted in the highest soluble protein content (54.49 mg g^{-1}) (Figure. 11 &12) and the maximum nitrate reductase activity (943.65 µg NO_2 h^{-1}g^{-1}) (Figure. 13 & 14) at shooting stage in both the seasons. High nitrate reductase activity indicates higher levels of protein synthesis and accumulation of soluble protein. This in turn indicates that nitrogenous compounds in the plants are well utilized for various metabolic activities (Mahadevan, 1988). Major part of soluble protein consists of RUBISCO enzyme, which is carboxylation or oxygenation enzyme. This is very essential enzyme for conversion of solar energy into chemical energy. Therefore, if the soluble protein is high, photosynthetic efficiency will be more, which may result in better yield. In the second season crop also, various physiological parameters *viz.,*nitrate reductase activity and soluble protein content, stomatal conductance, transpiration rate and net photosynthesis, estimated at shooting showed that all the above parameters had higher values with application of 100 per cent RDF along with *Azospirillum*@100g plant^{-1},phosphobacteria@100g plant^{-1} and AM fungi@100g plant^{-1} in a single row planting system. Higher stomatal conductance suggests that the treatment was effective in permitting more gaseous exchange leading to unhindered photosynthetic activity, which culminated in better vegetative growth and higher yields in these plants. Primarily, high status of moisture is required for proper stomatal conductance.



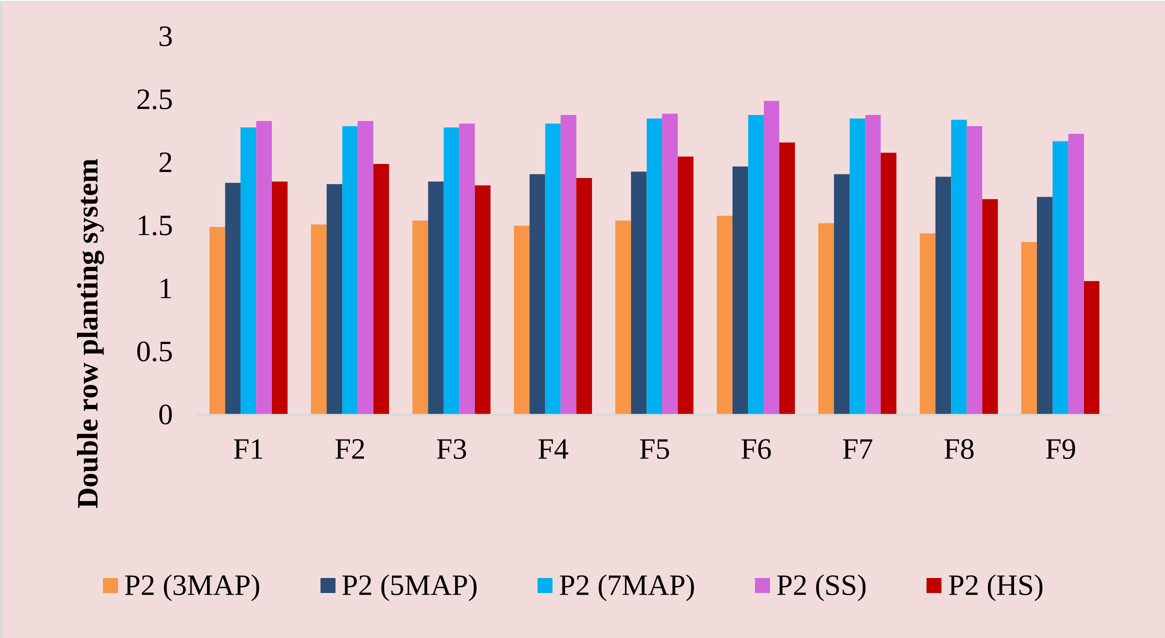
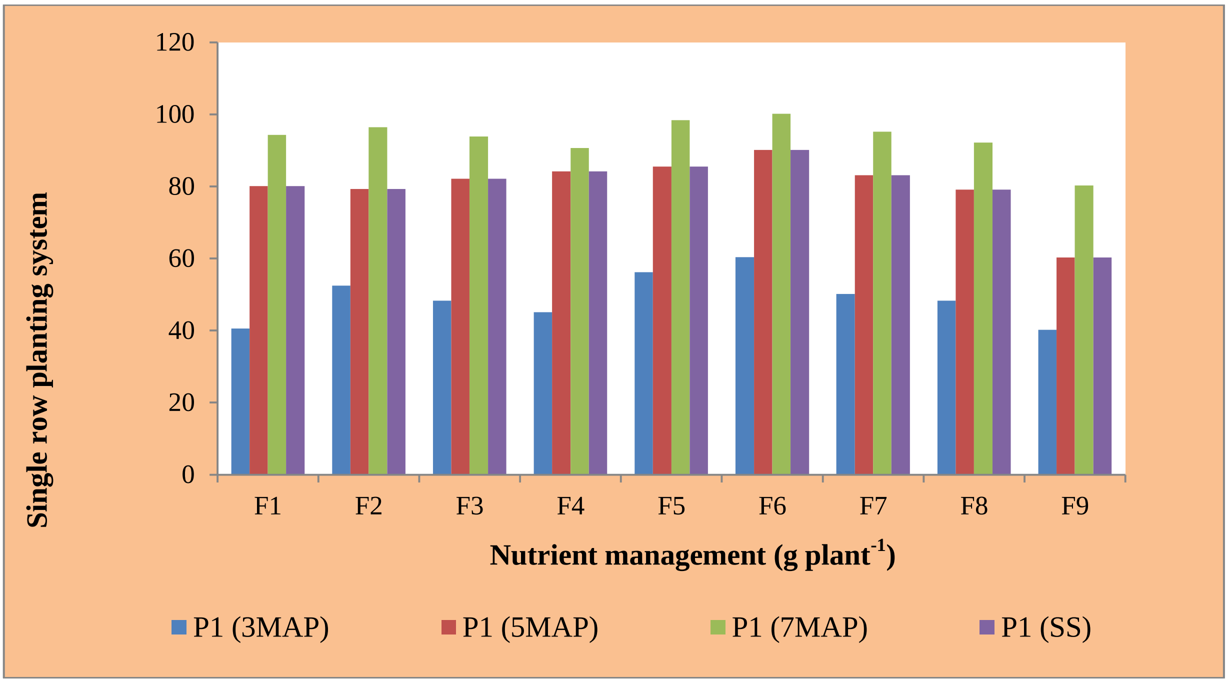


Fig 1: Effect of nutrient management and planting systems on total chlorophyll (mg g-1) content at different stages of growth of banana cv. Ney Poovan during first season crop



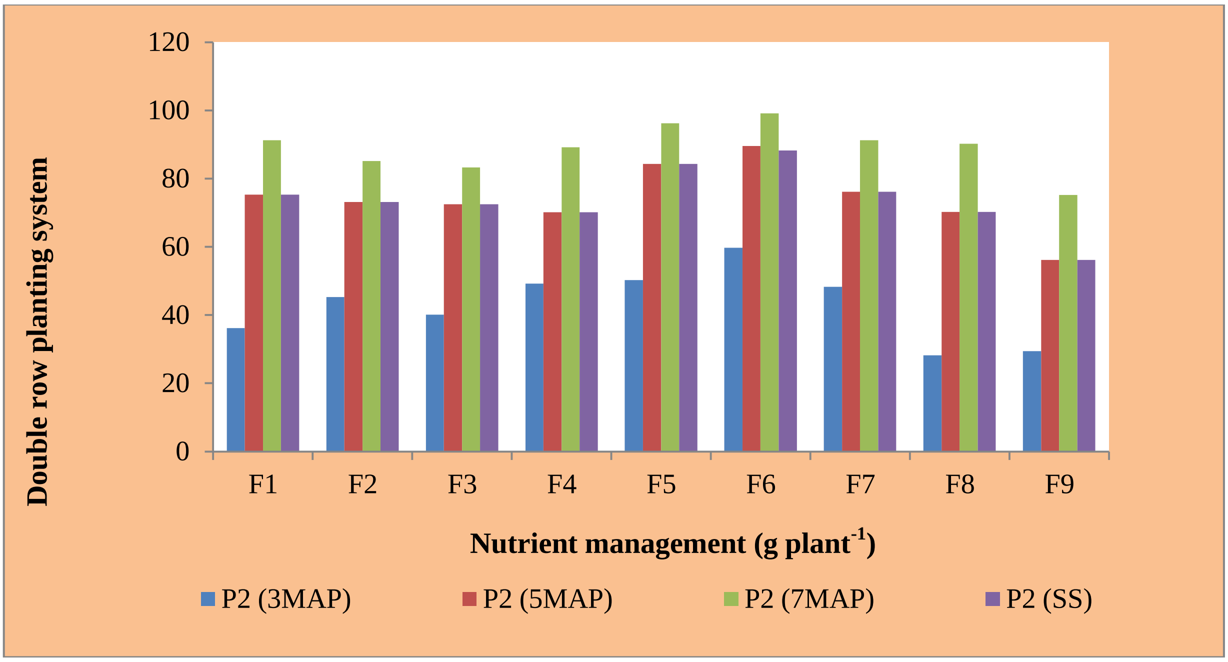
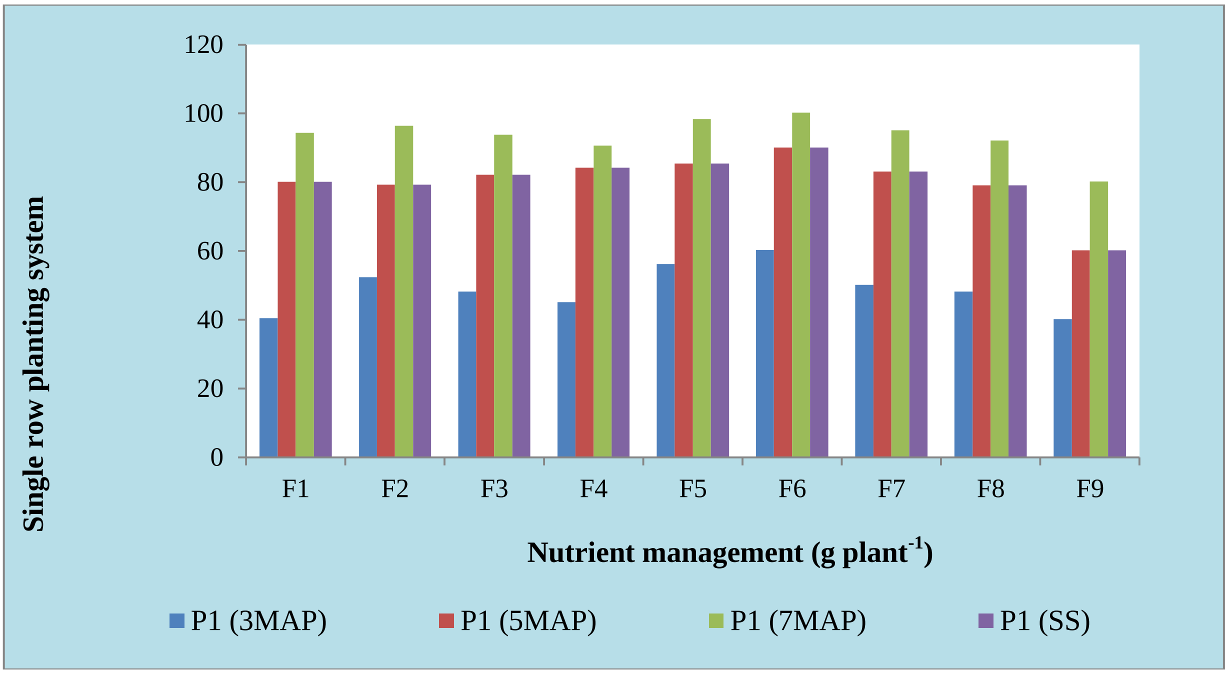


Fig 2: Effect of nutrient management and planting systems on total chlorophyll (mg g^{-1}) content at different stages of growth of banana cv. Ney Poovan during second season crop



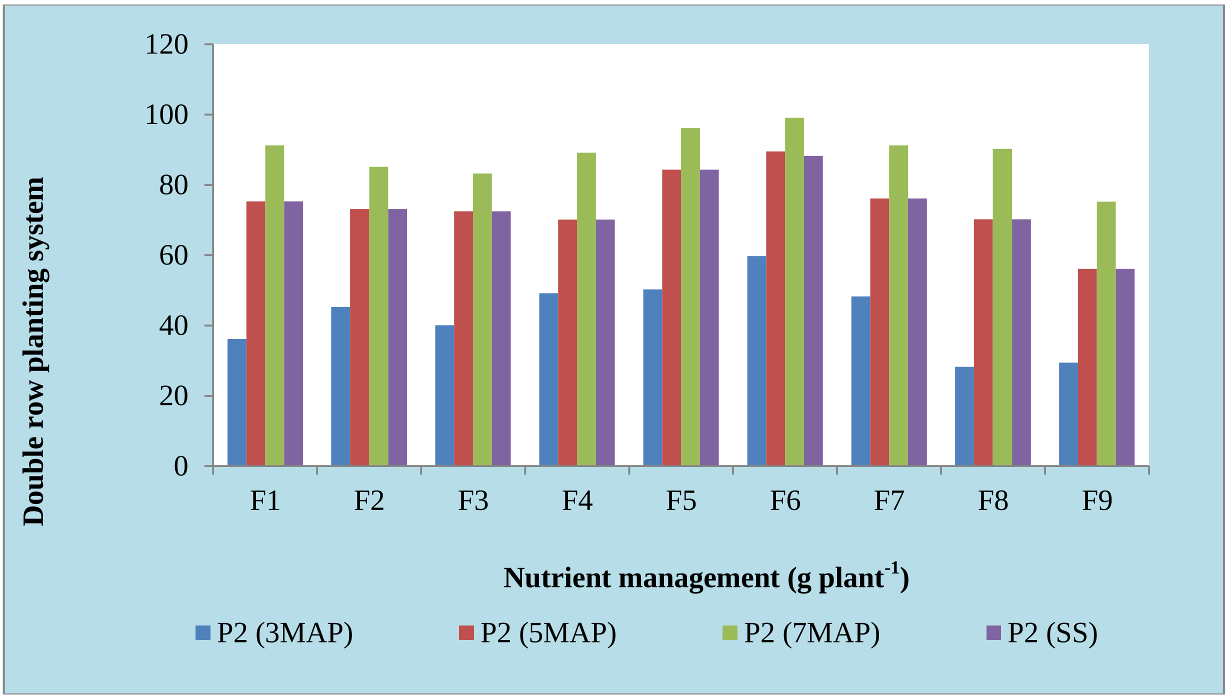
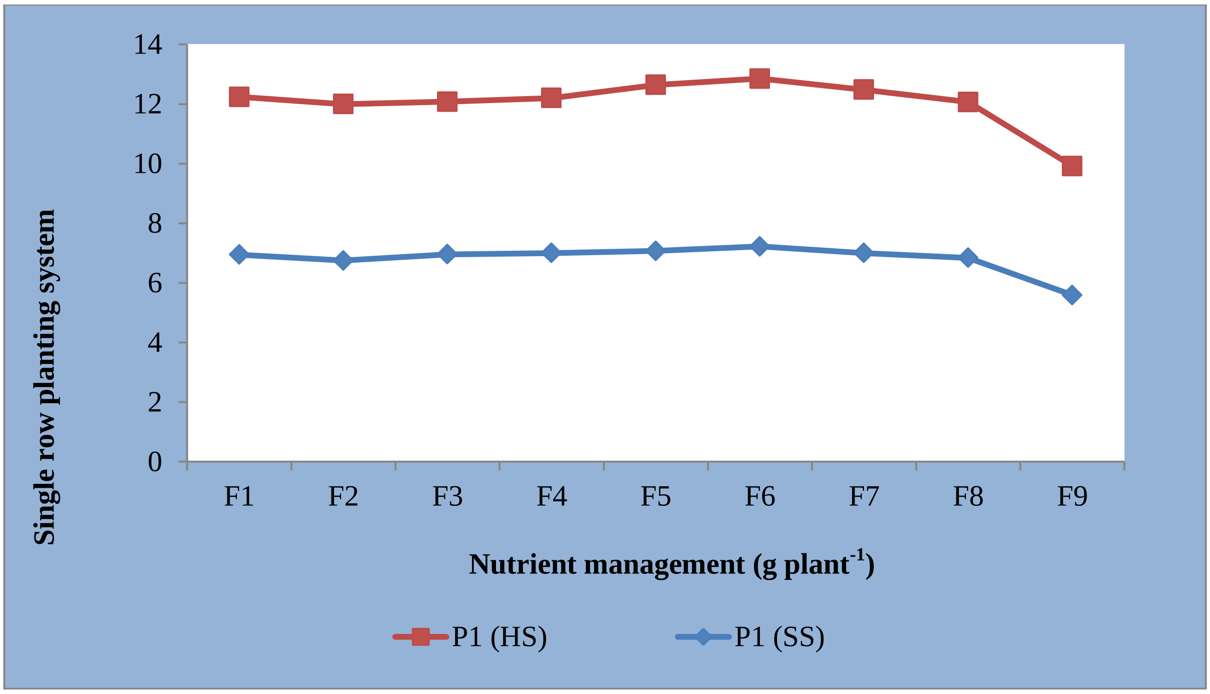


Fig 3: Effect of nutrient management and planting systems on light interception (per cent) of banana cv. Ney Poovan during first season crop



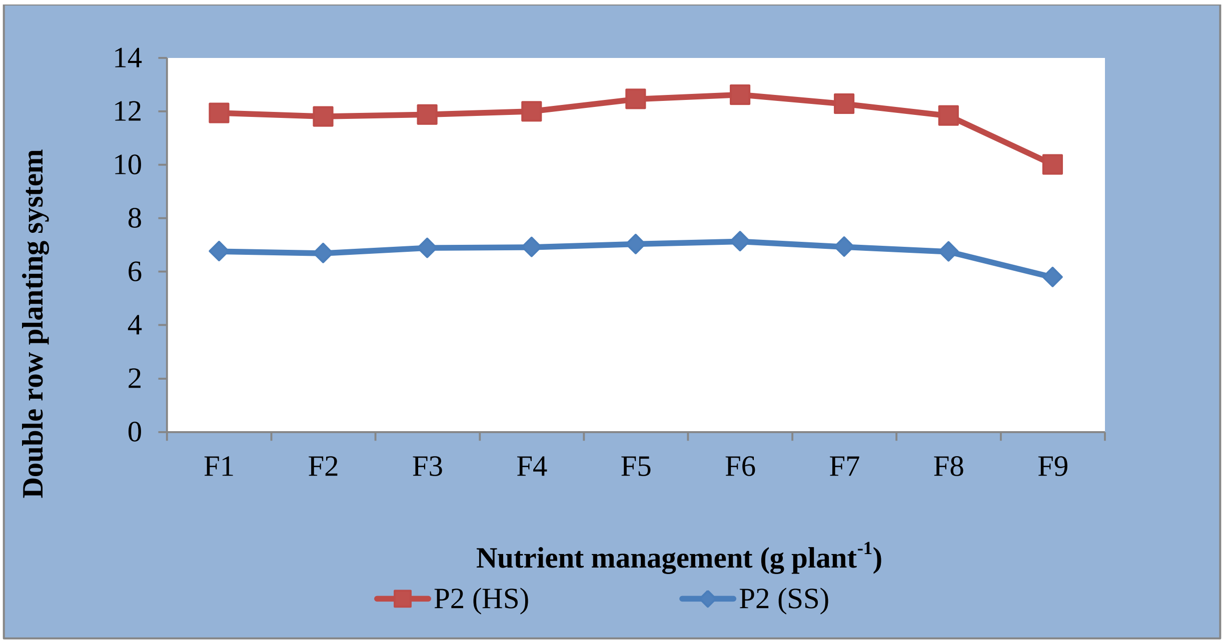
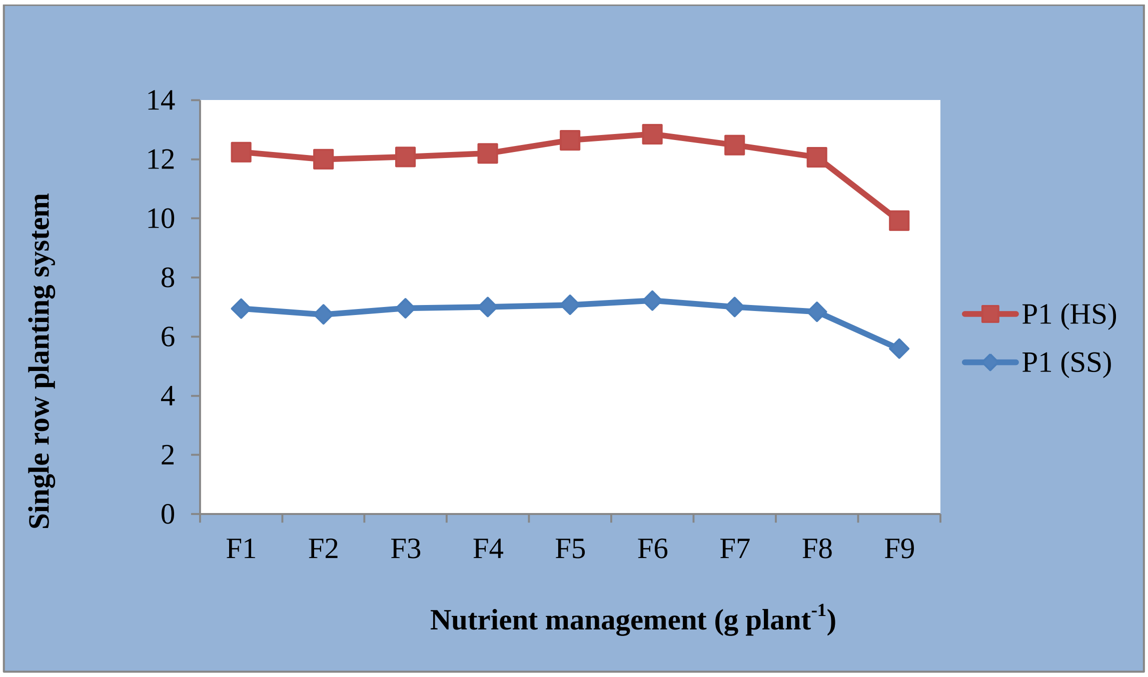


Fig 4: Effect of nutrient management and planting systems on light interception (per cent) of banana cv. Ney Poovan during second season crop



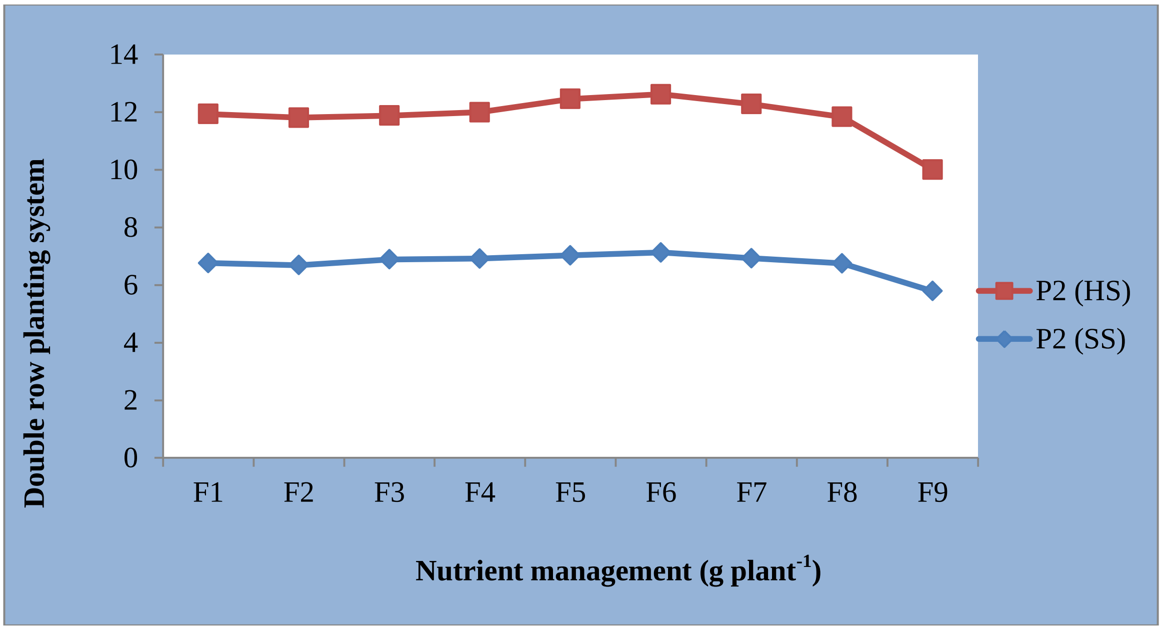
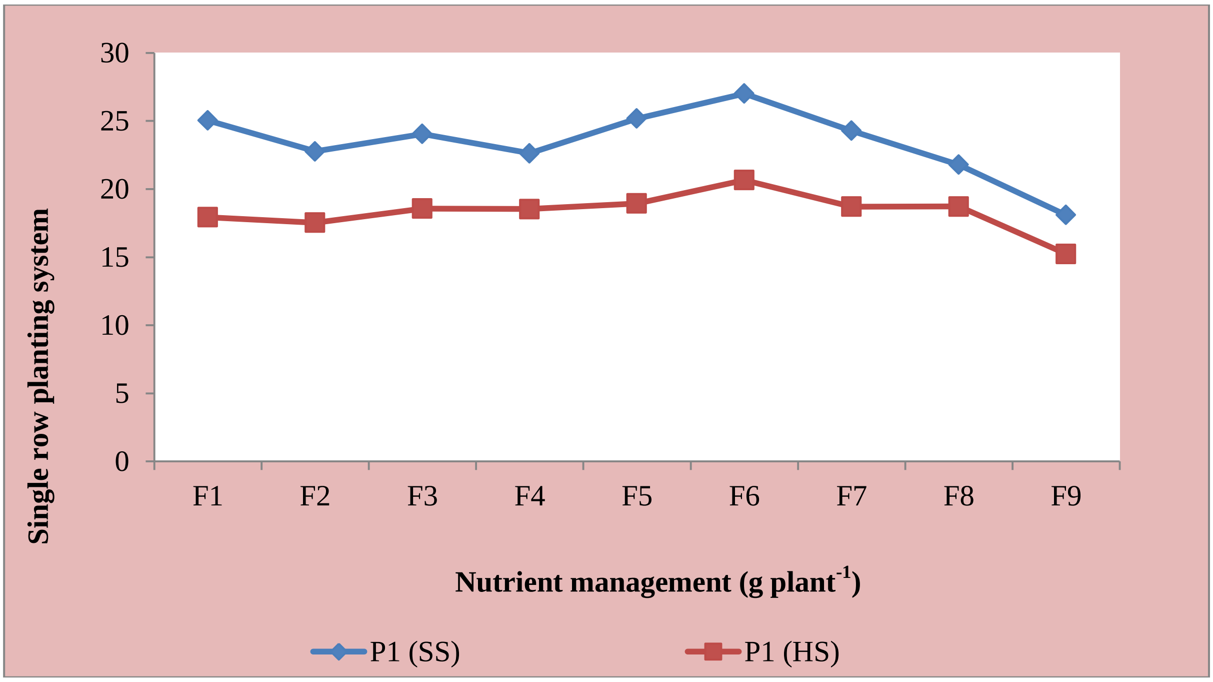


Fig 5: Effect of nutrient management and planting systems on transpiration rate (µgH_2O $cm^{-2}s^{-1}$) at different stages of banana cv. Ney Poovan during first season crop



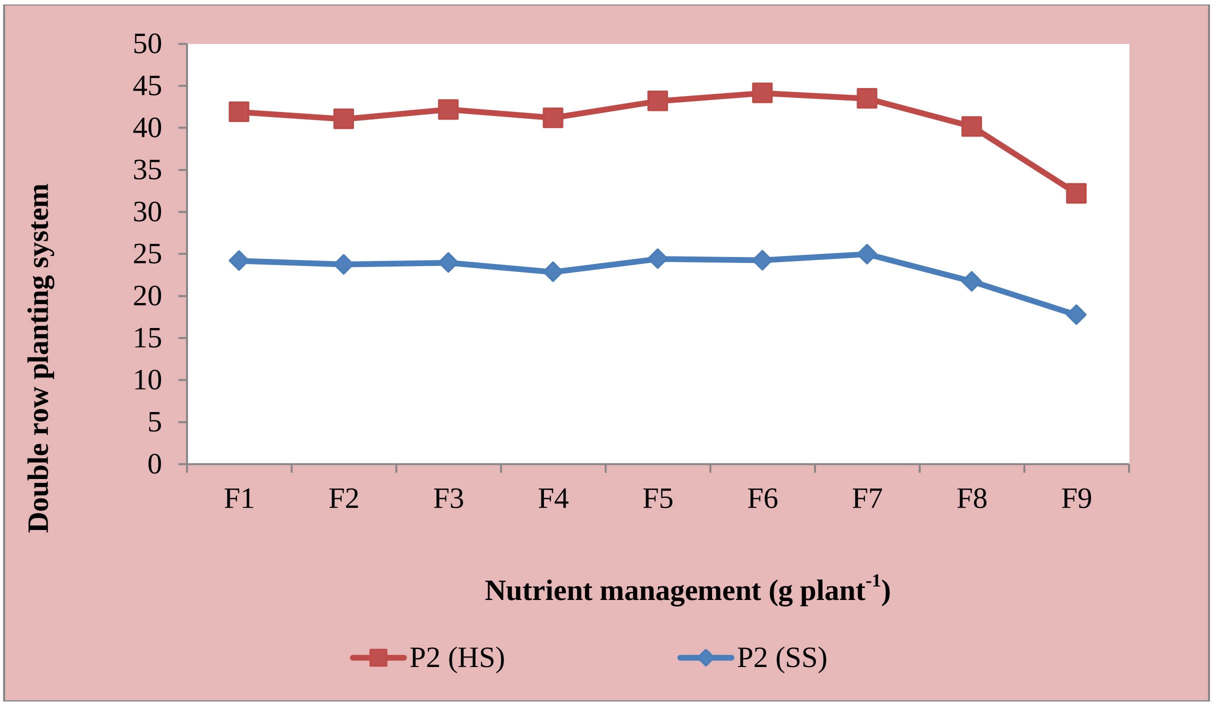
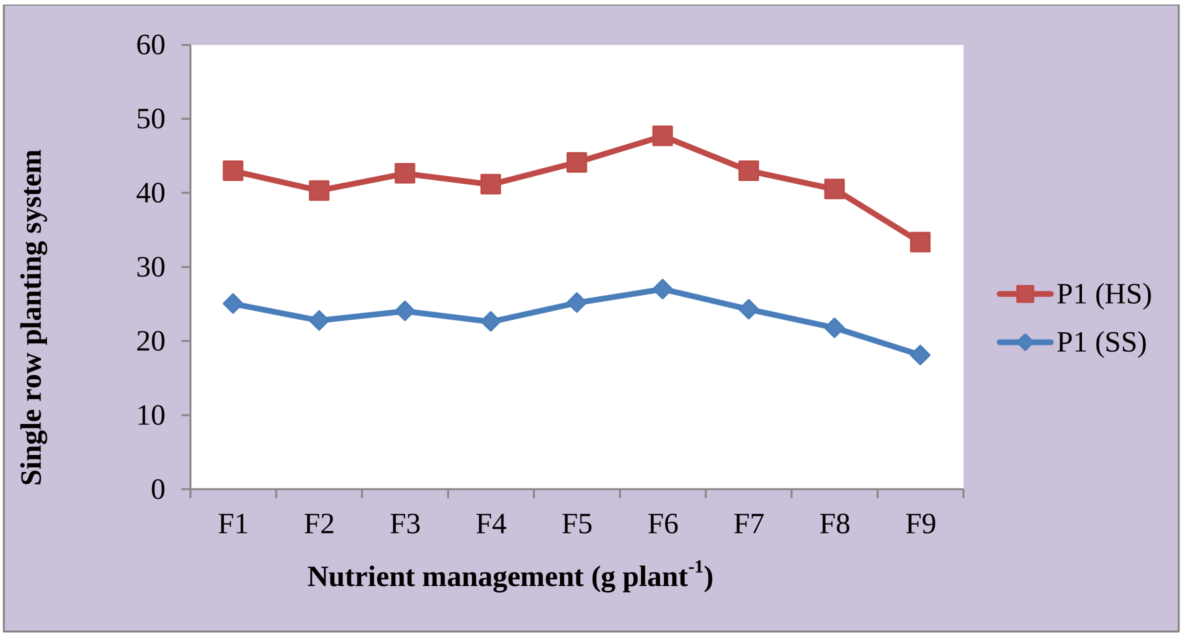


Fig 6: Effect of nutrient management and planting systems on transpiration rate (µgH_2O $cm^{-2}s^{-1}$) at different stages of banana cv. Ney Poovan during second season crop



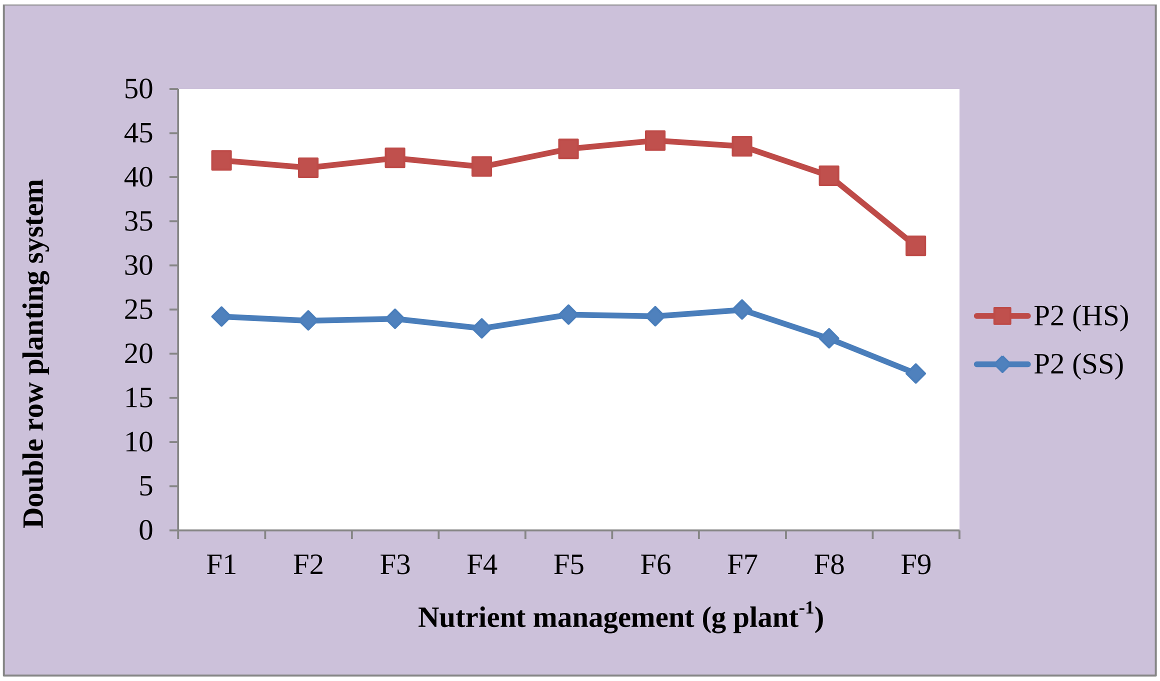
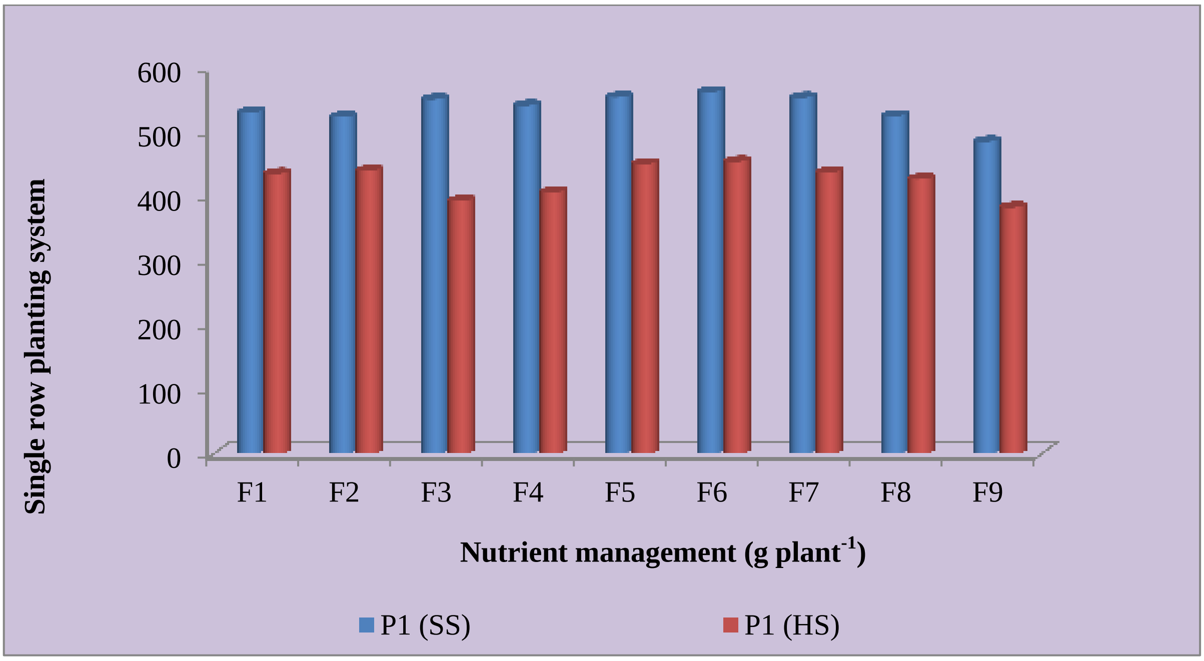


Fig 7: Effect of nutrient management and planting systems on net photosynthesis (µmol $m^{-2}s^{-1}$) at different stages of banana cv. Ney Poovan during first season crop



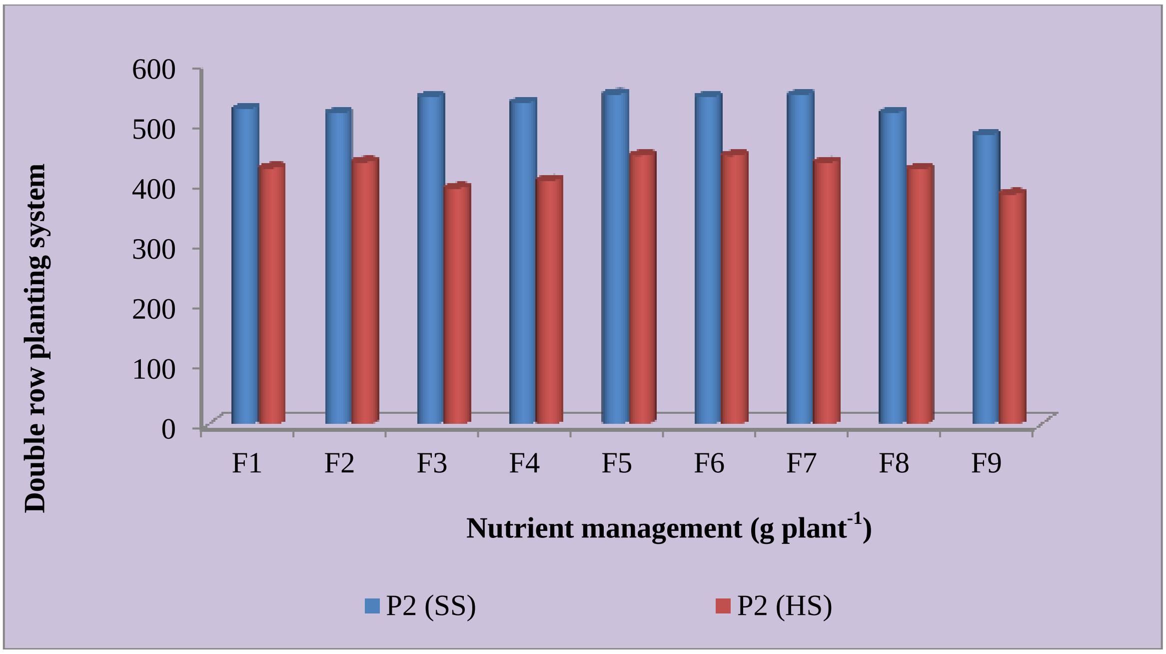
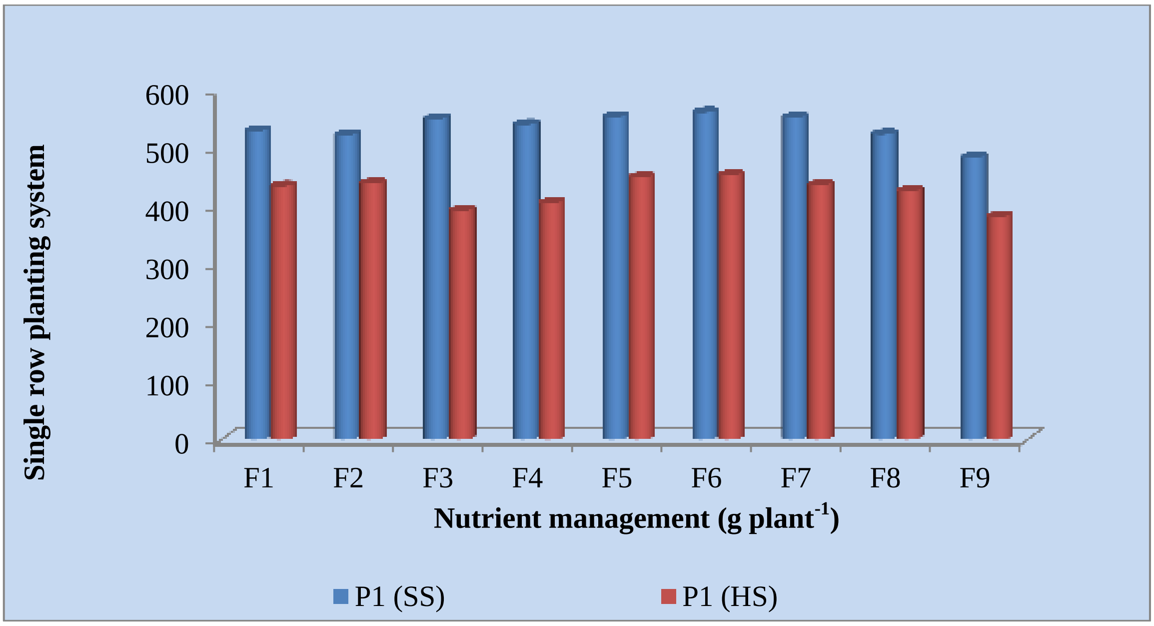


Fig 8: Effect of nutrient management and planting systems on net photosynthesis (µmol $m^{-2}s^{-1}$) at different stages of banana cv. Ney Poovan during second season crop



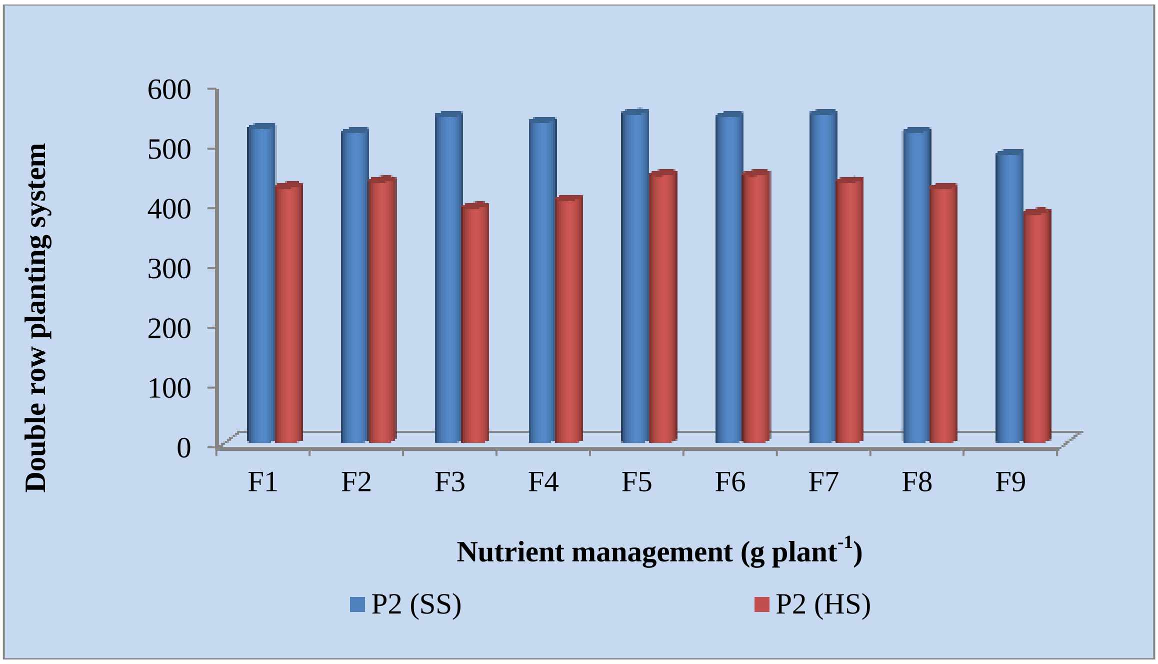
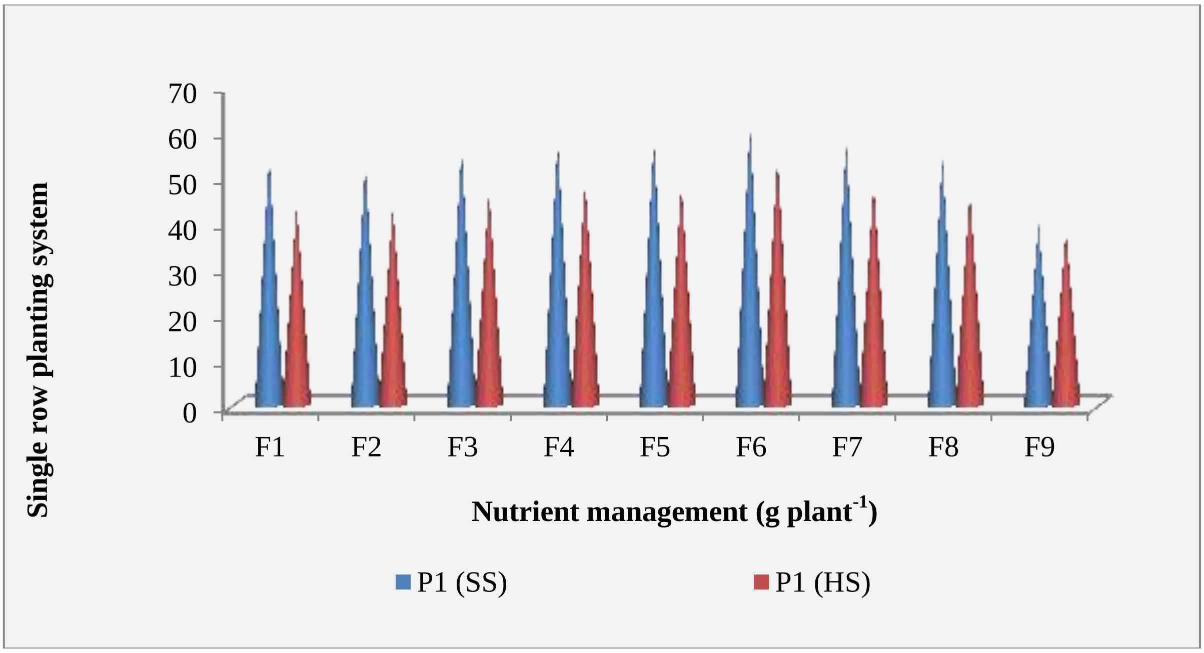


Fig 9: Effect of nutrient management and planting systems on stomatal conductance (mmol $m^{-2}s^{-1}$) at different stages in banana cv. Ney Poovan during first season crop



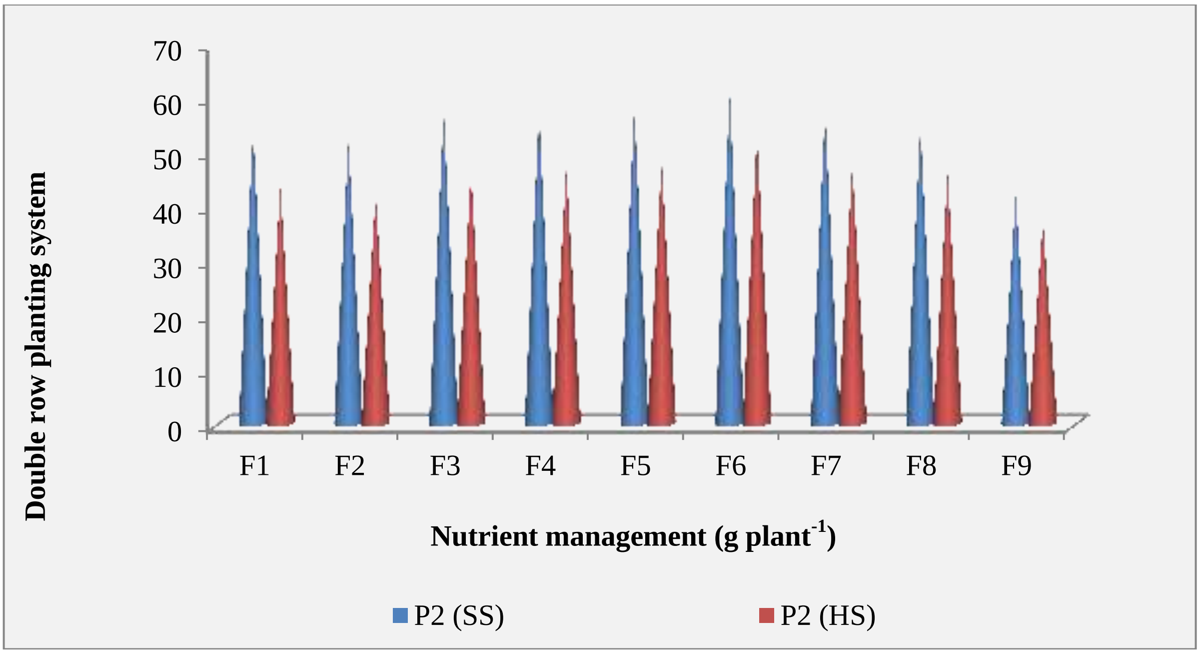
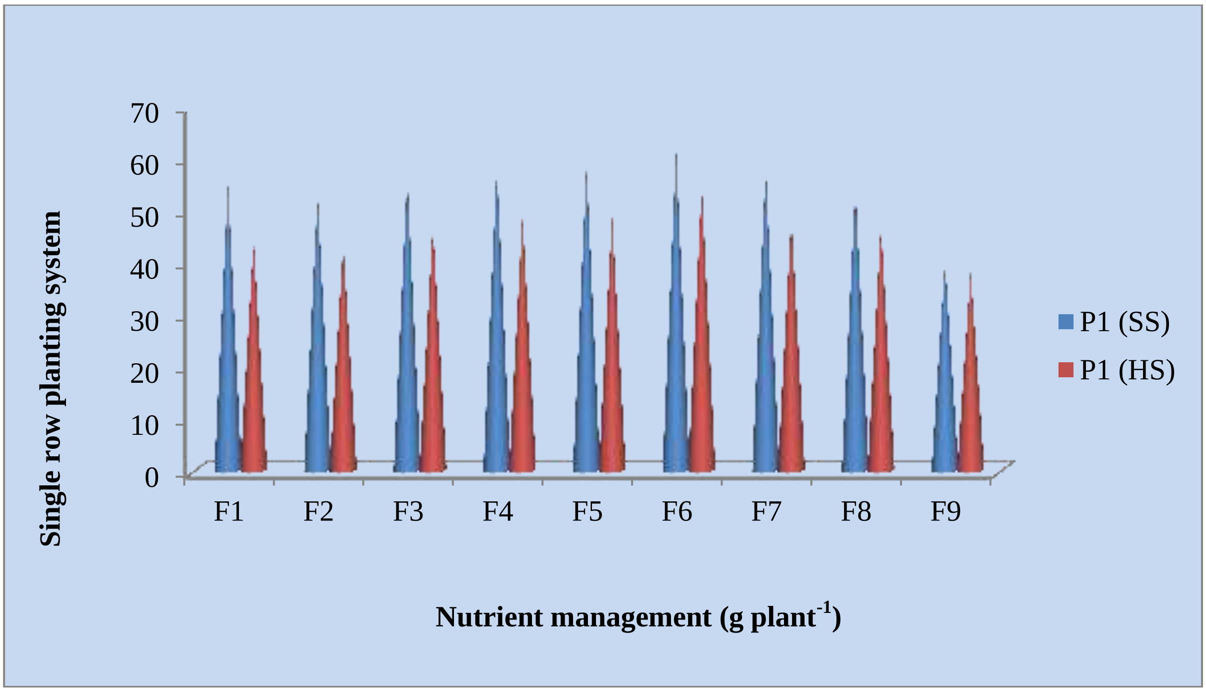


Fig 10: Effect of nutrient management and planting systems on stomatal conductance (mmol $m^{-2} s^{-1}$) at different stages in banana cv. Ney Poovan during second season crop



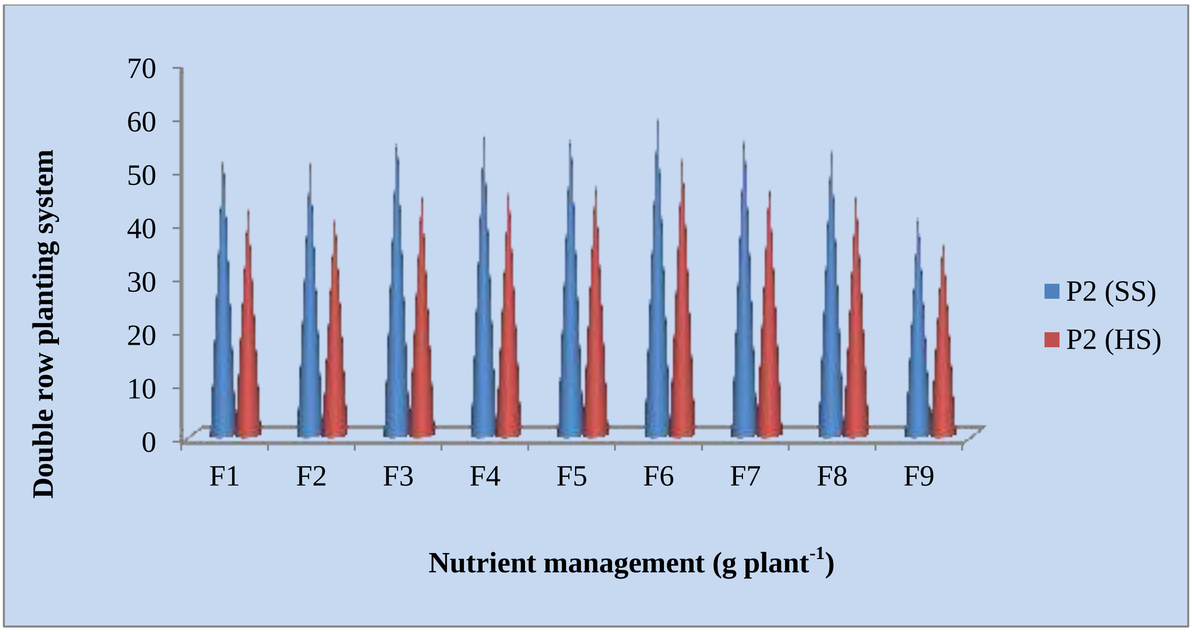
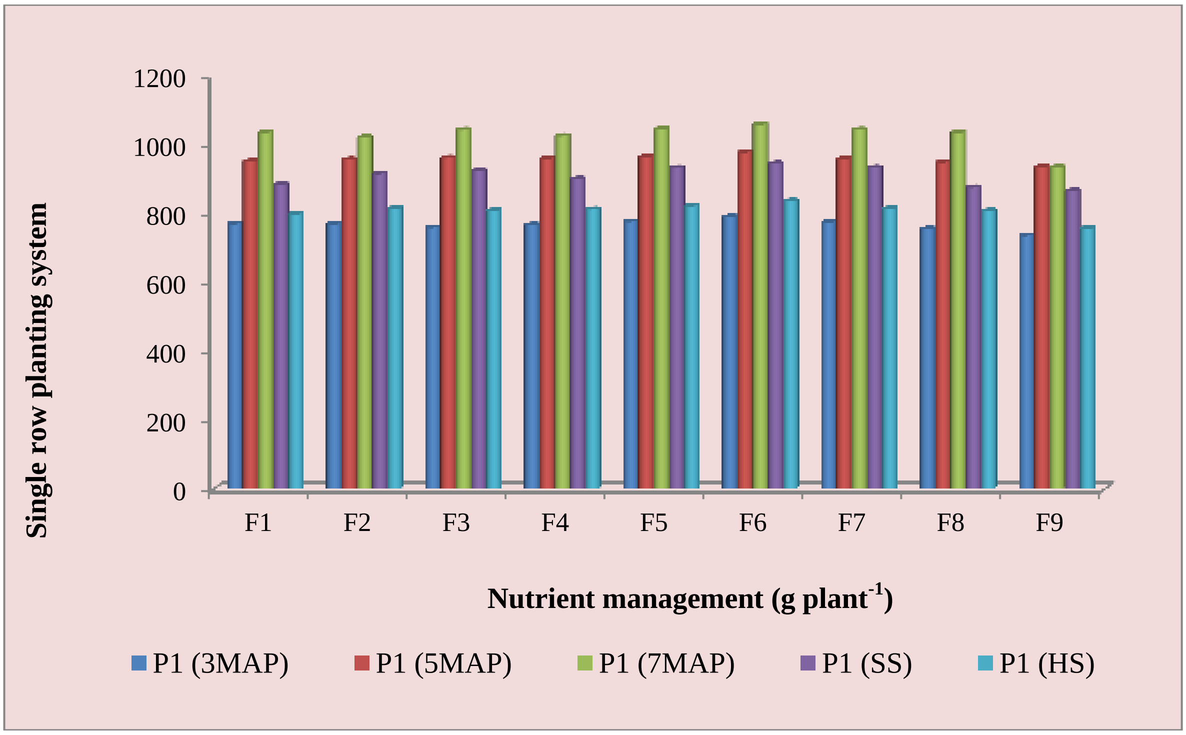


Fig 11: Effect of nutrient management and planting systems on soluble protein content (mg g^{-1}) at different stages in banana cv. Ney Poovan during first season crop



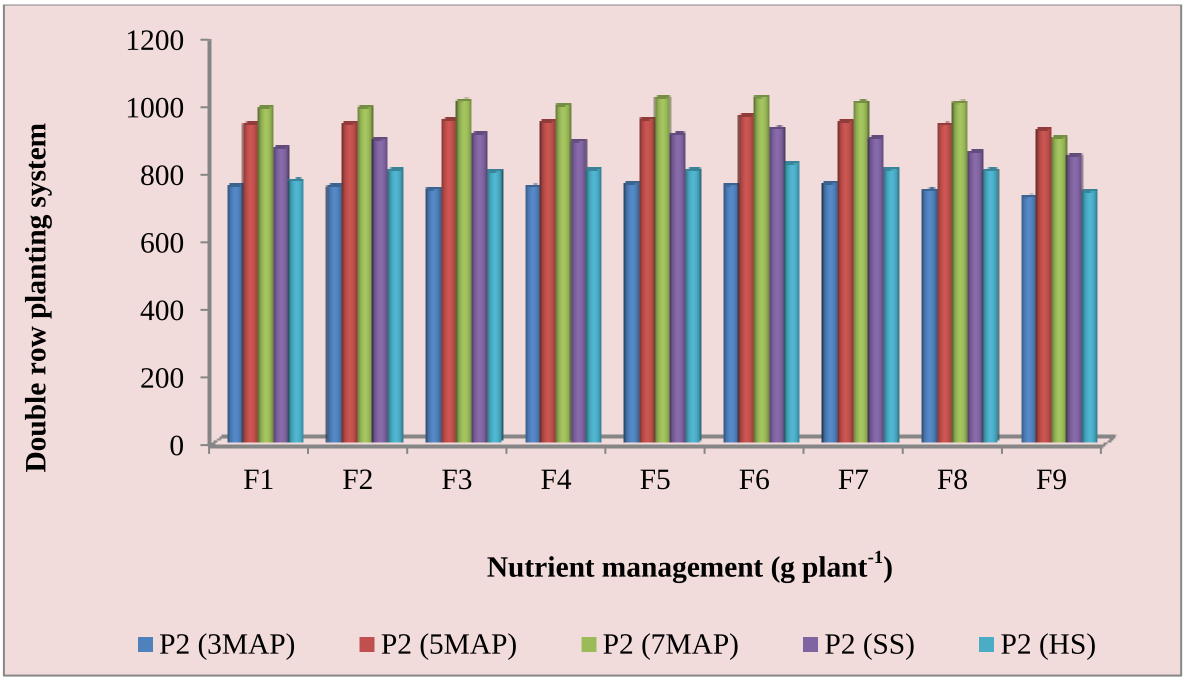
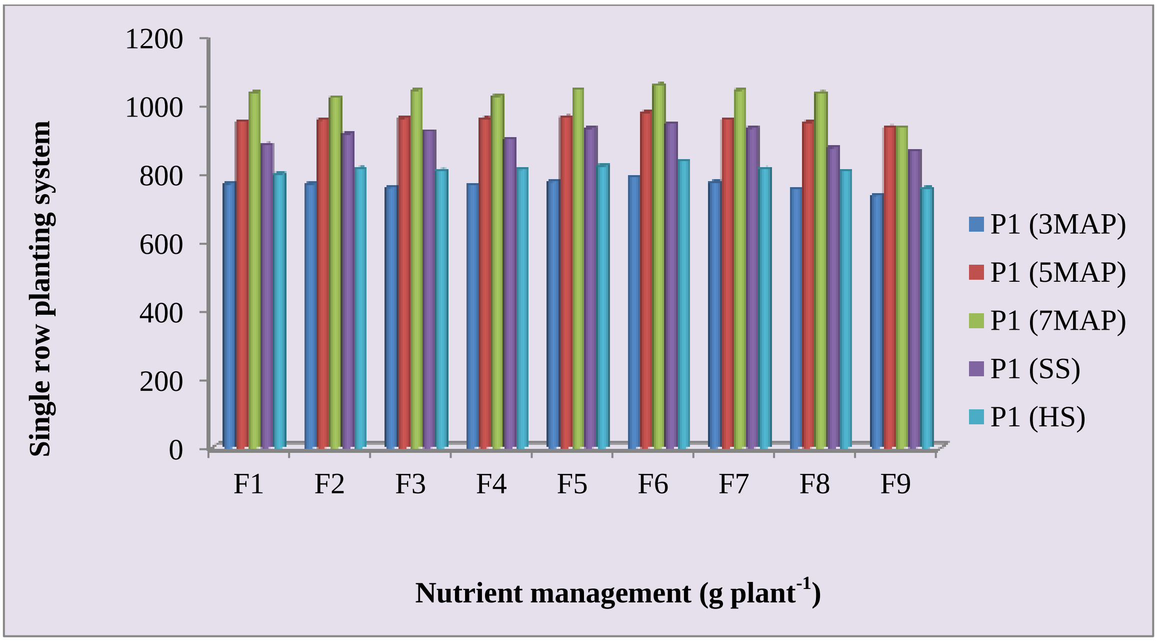


Fig 12: Effect of nutrient management and planting systems on soluble protein content (mg g^{-1}) at different stages in banana cv. Ney Poovan during second season crop



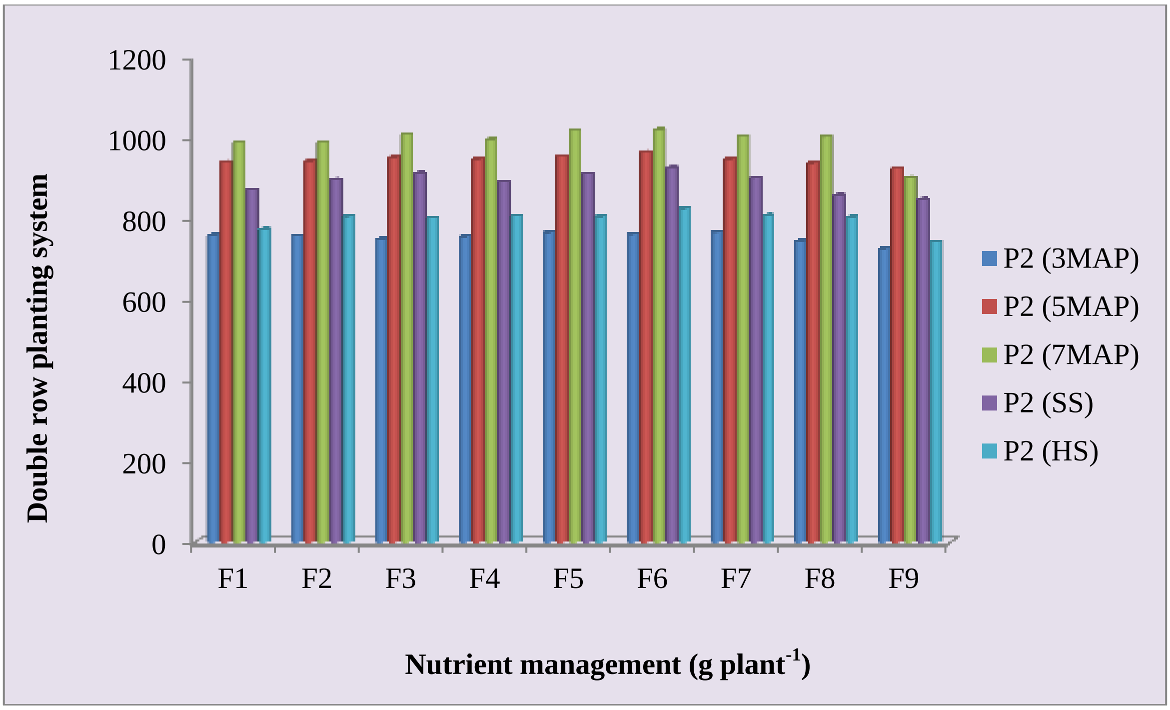
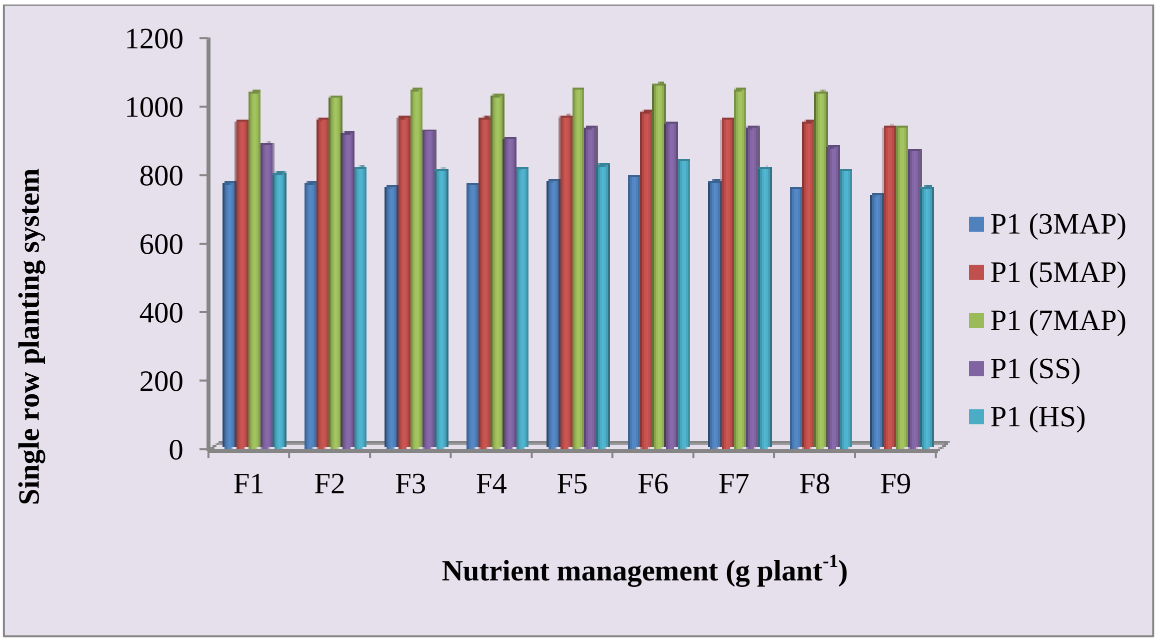


Fig 13: Effect of nutrient management and planting systems on Nitrate reductase activity (µgNO_2 $h^{-1}g^{-1}$) in banana cv. Ney Poovan during first season crop



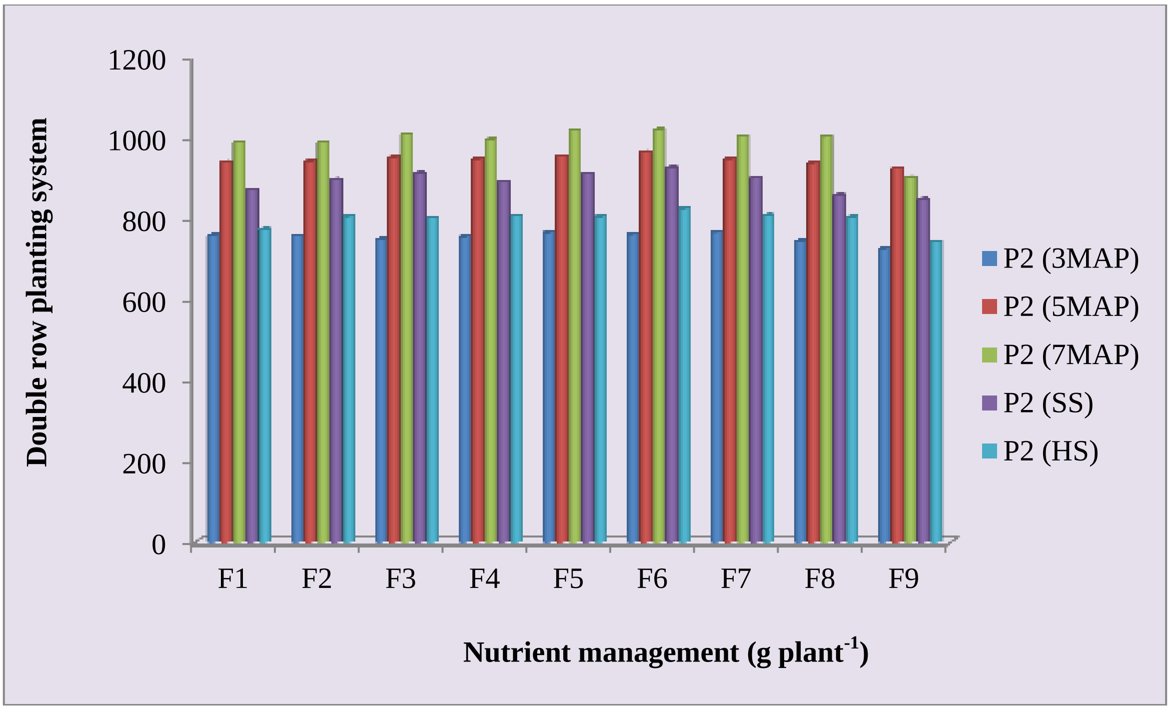


Fig 14: Effect of nutrient management and planting systems on Nitrate reductase activity (µgNO_2 $h^{-1}g^{-1}$) in banana cv. Ney Poovan during second season crop

Conclusion

Increased total chlorophyll, nitrate reductase activity and soluble protein contents were observed in the treatment combination of 100 per cent RDF along with *Azospirillum* @ 100g $plant^{-1}$+ phosphobacteria @ 100g $plant^{-1}$+ AM fungi @100g $plant^{-1}$ in single row planting system both in both the season crops ($F_6 P_1$). Light interception, Net photosynthesis, transpiration rate and stomatal conductance were also maximum in the treatment $F_6 P_1$ in both the seasons.

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