COMPARATIVE PERFORMANCE OF SOYBEAN (*Glycine max* (L.) Merrill) VARIETIES

BY

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THESIS

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Department of Agronomy

COLLEGE OF HORTICULTURE

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DECLARATION

I hereby declare that this thesis entitled "Comparative performance of soybean (*Glycine max* (L.) Merrill) varieties" 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 to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara,
October, 1981.

(PUSHPAKUMARI, P)

CERTIFICATE

Certified that this thesis entitled "Comparative performance of soybean (*Glycine max* (L.) Merrill) varieties" is a record of research work done independently by Miss. Pushpakumari, K. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

Vellanikkara,
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CERTIFICATE

We, the undersigned, members of the Advisory Committee of Miss. Pushpakumari, K., a candidate for the Degree of Master of Science in Agriculture with major in Agronomy, agree that the thesis entitled "Comparative performance of soybean (*Glycine max* (L.) Merrill) varieties" may be submitted by Miss. Pushpakumari, K. in partial fulfilment of the requirements for the degree.

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INTRODUCTION

INTRODUCTION

Soybean is considered to be an important source of edible plant protein and vegetable oil in many countries, especially as it contains about 40 per cent protein and 20 per cent oil. Though it had been accepted for large scale cultivation in many countries and though attempts were made to introduce this crop into India since long, its cultivation had not so far been taken up on a large scale in India. The main reasons for the poor acceptance of soybean as a commercially important crop in this country are considered to be the poor consumer acceptability of the crop produce and the non-availability of suitable varieties and production technology. To get over these difficulties, large scale experimental work was done in several research centres in India as part of the All India Co-ordinated Soybean Improvement Project from the 1960's. In a similar work done at the IARI Sub Centre, Coimbatore with the primary objective of selecting varieties suitable for South India, a large germplasm material of over 1000 types were screened. This work indicated that several varieties came up well in South Indian conditions and about 25 varieties were found to be most promising. The performance of these varieties was tested at the College of Horticulture for three years since

1976. This initial screening work indicated wide difference in the performance of these soybean varieties both within a season and also between seasons. With a view to study the performance of the initially screened superior varieties further in relatively large plots, the present investigation was taken up. There were 13 varieties included in this trial during the first season (June to October) and 14 in the second season (October to January).

The primary objectives of the study were

(1) To study the performance of soybean varieties and to select superior varieties suited to Kerala.

(2) To study the comparative performance of the varieties in the south west and north east monsoon seasons of Kerala.

(3) To study the nutrient uptake pattern of the varieties.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Yield potential is considered to be the most important parameter for the selection of a crop variety. However this character is the end result of the interaction of a number of other, often interrelated characters. Wide variations in the seed yield and associated characters in soybean varieties have been reported by many workers. A brief review of the work done on the performance of different varieties of soybean in India and abroad is given below.

I. Growth characters

A. Varietal comparison on growth characters

(a) Height of plant

Rao and Menon (1971) reported that plant height varied from 12.6 cm to 49.6 cm in their study with 37 soybean cultivars at Coimbatore. The same authors in 1976 observed variations in height (15.30 to 87.75 cm) among 91 soybean cultivars tested at the same centre. Significant differences in plant height of soybean varieties under the same maturity group was reported by Poonia (1979). Singh and Prasad (1979) reported significant varietal variation in plant height among seven soybean varieties tested and he observed that the maximum height was recorded by the variety C 39-24, which was at

par with PC 65290, but superior to all other varieties viz., PC 7034, PC 59021, PC 14437, Improved Pelican and Braj. Similar significant varietal variation in plant height were reported by Rajasekharan et al., 1980 and Gillioli, 1981.

Veeraswamy and Rathinaswamy (1975), Rosca et al. (1979) and Rajasekharan et al. (1980), observed positive correlation between plant height at maturity and seed yield plant^{-1}. Plant height at first flower anthesis was significantly correlated with yield (AVRDC, 1976). Karcher (1976) reported that tall varieties like Vada, Jupiter, Improved Pelican, Colombus and Calland were the highest yielders.

Gillioli (1981) in a field experiment found that in the early growth stages plant height was related to seed size.

No positive correlation between plant height and grain yield was observed by Choudhary et al. (1977).

(b) Number of branches

Patel et al. (1976) observed that the number of branches and leaves plant^{-1} were higher in late maturing cultivars and they were the highest yielders also. Tayo (1977) reported significant variation in number of branches plant^{-1} among three soybean cultivars tested. Similar significant varietal variation in number of branches plant^{-1}

was reported by Singh and Prasad (1979). They also observed that the number of branches plant^{-1} was maximum (6.40) in the variety T 39021 which was significantly superior to T 1437 and Bragg, but on par with all other varieties tested viz., T 7034, T 0329, T 39024 and Improved Pelican. But Rajasekharan et al. (1980) did not observe any significant difference in number of branches per plant among the 60 varieties tested.

Shamsuddin and Ahlan (1976) observed positive correlation between number of branches plant^{-1} and weight of seed plant^{-1} in cultivars Bragg, Wilkett 71 and Lee 68. Number of branches showed positive correlation with days to flowering, number of pods plant^{-1} and seed yield; negative correlation with 100 seed weight and number of seeds pod^{-1} (Rajasekharan et al., 1980).

(c) Number and weight of nodules per plant

Weiss (1949) reported genetic differences in nodulation of soybean lines. Weber et al. (1971) observed that in mixed Rhizobium japonicum populations, the competitive ability of strains in forming nodules is influenced by the host genotype, planting date, temperature and their relative numerical strength.

(d) Growth analysis

According to Weber et al. (1966) and Buttery (1969), soybeans did not exhibit an optimum leaf area index.

Hanway and Weber (1971a) observed variation in crop growth rate ranging from 8.0 to 14.9 g m^{-2} day^{-1} in soybean varieties.

According to Shibles et al. (1975), cultivars differed in photosynthesis independently of leaf area index. Tiwari et al. (1977) observed positive correlation between LAI and yield $plant^{-1}$.

No relationship between leaf area and seed yield was reported by AVRDC, 1976. Santos Filho et al. (1979) also observed similar results. The same authors again observed varietal differences in the leaf area index (LAI) and net assimilation rate (NAR). The varieties Pel selection 8 and Pel selection 5 exhibited the highest leaf area indices on 50th day and the values were 4.79 and 4.25 respectively. But highest NAR was noticed on 20th day in Pel selection 8 and on 34th day in Pel selection 5 and the NAR decreased to zero at 76th day after emergence in both the cases.

Venchukov et al. (1980) reported that one late cultivar VNIIS -1 had a maximum leaf area of 50, 400 m^2 ha^{-1}, LAI of 1.79 g m^2 and seed yield of 0.62 t ha^{-1}. Respective values for another late cultivar, 'Rossonolka' were 75,000 m^2 ha^{-1}, 2.45 g m^{-2} and 1.75 t ha^{-1} and for a mid late cultivar were 72,700 m^2 ha^{-1}, 2.09 g m^{-2} and 1.85 t ha^{-1}.

(c) Dry matter production

Borst and Thatcher (1931) observed that the increase in dry weight of soybean was slow during initial stages of growth and rapid thereafter. Vegetative growth of soybean ceased with the commencement of seed development (Howell, 1960). Drager et al. (1969) observed significant difference in the photosynthetic ability of soybean varieties. The rate of photosynthesis for seedlings of 36 varieties of soybean ranged from 12 mg of CO_2 dm^{-2} hr^{-1} in Patterson to 24 mg of CO_2 dm^{-2} hr^{-1} in Richland at saturated light intensity (Curtis et al., 1969). The highest varietal difference in photosynthesis observed by Jeffers and Shibles (1969) was 4 mg CO_2 dm^{-2} hr^{-1} while Hansen (1972) reported differences upto 2 g CO_2 m^{-2} hr^{-1} in soybean cultivars.

Ashley (1977) noticed positive correlation between apparent photosynthetic rates of leaf canopies and yield. In a study involving three soybean cultivars, significant varietal difference in dry matter yield was reported by Bryant et al. (1976). According to Johnson and Major (1979), the above ground yield was positively correlated with seed yield.

(d) Number of days to flowering

Number of days required for first flowering in soybean varieties ranged from 27.0 to 56.5 days and for 50 per cent flowering the range was 29.5 to 55.7 days

(Rao and Menon, 1971). They had classified the varieties C 39021, Improved Pelican and TAU-15 as early maturing.

(g) Days to Maturity

Rao and Menon (1971) observed a varietal variation of 79.3 to 126.7 days for maturity, among 37 soybean varieties tested under Coimbatore condition (11°N). The varieties C 39024, C 39021, Davis, Improved Pelican, Bonetta, and Bragg took 91.3, 84.2, 81.7, 85.6, 77.3 and 72.2 days respectively, for maturity. In another varietal trial involving 31 varieties, the same authors in 1976 observed a varietal variation of 82.17 to 109.76 days for maturity. Saxena and Pandey (1971) also reported varietal difference in the maturity of 16 soybean varieties at Pantnagar.

(i) Number of nodes per plant

Rao and Menon (1971) reported that the number of nodes per plant varied from 6.8 to 17.4 among 37 soybean varieties tested and the varieties EC 39000 and C 7034 recorded the highest values. In another trial involving 31 genotypes the same authors in 1976 confirmed the superiority of the above varieties with respect to this character.

Tiwari et al. (1977) reported that the number of nodes remained almost the same in all the varieties studied except in cultivars Ab-1 and Semmes.

3. Seasonal effects on growth characters

In general, mid season sowing gave taller plants compared to early and late sowing ones (Weiss et al., 1950; Fisher and Carter, 1954; Hartwig, 1954; Abel, 1961; and Hoffel, 1961).

Byth (1968) observed an increase in plant height, node number, internode length, days to flowering and days to maturity when day length is changed from 8 to 16 hours. Hinga (1976) reported that when day length is increased by half-an hour, the number of days to flower and days to maturity were also increased.

Schuster and Jobehdar-Honarmejad (1976) observed a decrease in the length of vegetative phase with decrease in temperature, in all the 10 cultivars tested. They further noticed that the rate of growth and plant height were greater in high temperature and long photoperiods.

Graves and De Datchen (1976) in a trial at Milan with eight soybean cultivars and three dates of sowing (15th May, 30th May and 15th July) noticed decreased plant height due to delayed sowing.

Woodbar and Begg (1976) observed that the total dry weight of plant tops, dry weight of stems and number of nodes plant^{-1} were reduced in low humidity environment. Environmental factors such as altitude, latitude, day length, maximum temperature and minimum temperature had no

significant effect on plant height or number of days from flowering to maturity (Chigbau et al., 1976). Dunnah and Rank (1980) observed significant genotype x environment interaction on plant height at maturity and number of nodes plant^{-1}.

Nigbau and Minor (1976) reported that optimum air temperature for photosynthesis in soybean was 25 to 30°C. They also reported that moisture deficiency during vegetative phase resulted in reduced plant growth.

No seasonal difference in LAI was noted in three cultivars tested by Tishiri et al. (1980). Decrease in plant height, leaf dry weight, stem dry weight and leaf area per plant due to delayed sowing from 15th May to 30th May was reported by Seyeda et al. (1981) in Egypt.

Singh et al. (1973) observed seasonal variation in flowering and maturity of 10 soybean cultivars tested in Tarai region of Uttar Pradesh. All the varieties grown from October to December took longer periods to flower and mature while the same varieties, when planted during September-October took minimum time. He attributed low temperature to be the reason for delayed flowering and maturity in the former season.

In an experiment at Pantnagar involving six varieties and different dates of sowing in two seasons (March to May and June to November), Pandey et al. (1977)

observed that the number of days to flowering was influenced by sowing dates in both the seasons. The effect was more marked in late than in early maturing genotypes. Early varieties were more sensitive to temperature than to length of dark period and in late maturing types the reverse was true.

II. Yield and yield attributes

A. Varietal comparison

(a) Yield attributes

Rao and Menon (1971) observed significant varietal differences in number of pods plant^{-1}, number of seeds plant^{-1} and weight of seed plant^{-1} in 37 soybean varieties tested and the respective values ranged between 7.9 to 7[illegible].1, 11.1 to 159.9 and 1.42 g to 10.70 g. In all these characters PK 7034 was superior. The same authors in 1970 confirmed the superiority of this variety with regard to the above characters.

Euler and Carter (1959) and Rajasekharan et al. (1980) also reported varietal variation in seed weight plant^{-1} in soybean.

(b) Yield

In an experiment involving 16 varieties, Saxena and Pandey (1971) observed that the variety Bragg was consistently superior to the other varieties tested, with regard to yield.

Ramachiar (1979) observed no significant varietal difference in yield among 36 varieties tested. But the highest yield of 575 kg ha^{-1} was recorded by JS 2750 followed by JS 79024.

Ogli et al. (1975) observed an yield variation of 1300 kg ha^{-1} to 1660 kg ha^{-1} among three soybean cultivars tested. Candilo et al. (1975) reported variation in seed yield ranging from 69 to 2440 kg ha^{-1} among 10 varieties tested. Agarwal and Tarang (1975) obtained maximum seed yield of 1720 kg ha^{-1} with cultivar Bragg followed by US No.1 and Clark 63.

In a varietal trial with six cultivars Singer (1976) observed the variety Jupiter as the highest yielder with an yield of 3 1 kg ha^{-1}. In the same trial, the cultivars [illegible] and Improved Pelican also gave high yields but they were found to be susceptible to diseases. Patel et al. (197) in a trial with 12 soybean cultivars observed that the cultivar Hampton 266 was the highest yielder.

Singh and Prasad (1979) observed an yield variati n of 300 kg to 1550 kg ha^{-1} among seven soybean cultivars tested, the highest yielder being cultivar [illegible]. Seed yield variation of 302 to 1145 kg ha^{-1} was observed with eight soybean cultivars under Brazil conditions (Mahlan, 1979).

Differences in seed yield with soil type was reported by Murtea and Ugenu (1979). They observed

variation in seed yield ranging from 2600 kg ha^{-1} in cultivar Columbus to 4630 kg ha^{-1} in cultivar Hodgson on a calcareous soil and 500 kg ha^{-1} in cultivar Steele to 3490 kg ha^{-1} in cultivar Summes on a clay soil.

Rajasekharan et al. (1980) obtained an yield of 5640 kg ha^{-1} under Coimbatore conditions for the variety TMV-1.

According to July (1981) the most stable varieties with regard to yield at 0 to 10° latitude were Davis and Forrest. But for 10 to 20° latitude the varieties were Bossier, Davis and Jupiter. He also reported that stability of cultivars varied from continent to continent than from season to season.

(c) Correlation between yield and yield components

Saxena and Sandey (1971) reported that seed yield was associated with characters like number of pods $plant^{-1}$, 100 seed weight, and number of days to maturity and they account for 90 per cent variation in seed yield of soybean. Veeraswamy and Ratnaswamy (1975) observed that the number of pods $plant^{-1}$ had the greatest direct effect on seed yield than any other associated character. They further reported that the number of pods $plant^{-1}$ will serve as measurable component of yield in soybean.

Choudhary et al. (1977) reported that grain yield was actually influenced only by the number of pods $plant^{-1}$

and test weight of seeds. A significant positive correlation between the weight of seeds plant^{-1} and the number of pods plant^{-1} was reported by Shamsuddin and Rahman (1976).

Hussain and Obasola (1975) in a field experiment with 10 lines of soybean observed that the seed yield was weakly correlated with pod and seed number plant^{-1}. They also reported that the seed yield was inversely correlated with number of seeds pod^{-1}.

In an experiment with 56 soybean cultivars, from different countries, it was reported by Rosca et al. (1975) that the seed yield plant^{-1} was correlated with lateness of maturity, plant height, 100 seed weight, number of pods plant^{-1} and protein yield plant^{-1}.

Rajasekharan et al. (1980) noticed negative correlation between 100 seed weight and number of pods plant^{-1} and yield and positive correlation with number of seeds pod^{-1}.

3. Seasonal effects on yield and yield attributes

According to Carter and Hopper (1942) seasonal conditions play an important role in modifying the size of soybean seeds. Osler and Carter (1954) found that seed weight was not appreciably affected by delay in planting, although there was a difference in varieties in this respect.

Rajan (1976) reported that number of pods plant^{-1}

was considerably higher for all the cultivars under long day conditions.

Environmental factors such as altitude, latitude, day length, maximum temperature, and minimum temperature had no significant effect on seed yield, seed weight and number of pods plant^{-1} in 10 soybean varieties (Nigam et al., 1970).

Purnah and Park (1980) observed significant genotype x environment interaction on number of pods node^{-1}, test weight and seed yield in soybean.

Weeks (1900) reported that extremely early planting was not desirable but late May or June planting would give best yields. Similar results were reported by Hartwig (1954), Gray (1959), Caviness and Smith (1959), Abel (1961) and Beffel (1961).

In an experiment at Maharashtra, Lad and Jadhav (1977) observed varietal difference in seed yield due to sowing dates. The variety Clark 63 gave highest seed yield when planting was done between 25th June and 20th August while sowing dates between 11th June and 20th August were best for Bragg. They also observed that the lowest yields were obtained from crops sown on 12th November.

Decreased seed yield due to delay in sowing from 15th May was reported by Graves and Mc Dutcher (1978) in a study involving eight soybean cultivars in Milan.

Yield of soybean is most affected by moisture stress during the pod filling period (Dusek et al., 1971 and Doss et al., 1974). Decrease in the number of pods plant^{-1} and reduction in seed yield due to moisture stress during flowering were reported by Dusek et al. (1971). They also reported that the number of seeds pod^{-1} remained unaffected due to moisture stress during flowering.

Whigham and Minor (1978) reported that in Puerto Rico, soybean yields were highest when plantings were done in May or June and lowest when planted in December and January.

III. Content and uptake of fertilizer nutrients

Percentages of N, P and K in the soybean plant parts at successive stages of plant development were determined by Hanway and Weber (1971b) and it was observed that the composition of plant parts from different varieties was usually similar. They also found a decline in nitrogen content in plant parts with age. Bataglia et al. (1977) reported that there were significant varietal differences in the content of all elements in soybean seeds, particularly for phosphorus.

According to Whigham and Minor (1978) potassium content of soybeans increased with increase in temperature upto 32°C. They also reported that nitrogen content in

plant tissue and seeds of uninoculated plants increased by increasing soil temperature from 19° to 30°C.

Lathwell and Evans (1951) indicated that the yield of soybean was closely associated with the amount of nitrogen that accumulated within the plant. Seed yield was significantly correlated with nitrogen content 71 days after planting while there was no correlation with nitrogen content 55 days after planting (AVRDC, 1976). Reena (1981) in a study with soybean variety JS 39021 observed that the nitrogen content of stem was highest in the initial stages and it declined markedly with advancement of crop growth. She also found that there was a slight increase in the nitrogen content of leaves from 30th day to 60th day and a sharp decline thereafte . Nitrogen uptake by stem and leaves showed a conspicuous increase between 30th and 60th day and a reduction in the advanced stage of crop growth. A gradual decrease in phosphorus and potassium contents of the stem and leaves with maturity was also observed by her. Uptakes of phosphorus and potassium by stem and leaves increased upto 60th day, after which there was a decline. She further observed a steady and conspicuous increase in the total uptake of phosphorus and potassium by plants upto 90th day and after that there was a gradual reduction.

IV. Quality aspects

A. (a) Varietal comparison on oil content

Shibles et al. (1975) reported that the seeds of modern cultivars of soybean contain about 21 per cent fat. In an experiment with three soybean cultivars, Agarwal and Narang (1975) obtained the highest seed oil content of 24.02 per cent in cultivar Bragg.

Albert (1975) found that oil content of seed was highest in mid early and mid late cultivars (21.8 to 21.9) and lowest in late cultivars (17.7). Similar result was obtained by Sood et al. (1977). Albert et al. (1976) in a study involving 18 cultivars, observed that the seed contents of protein and lipids depended more on the biological characteristics of a cultivar than on soil, climate and weather conditions.

Tang et al. (1977) in a study involving 12 soybean cultivars at six sites observed variations in seed oil content between varieties and sites. A varietal variation of 18.44 to 27.30 % of oil was observed by Sood et al.(1980).

(b) Varietal variation in protein content

Seeds of modern cultivars were reported to contain about 41 per cent protein (Shibles et al., 1975). Agarwal and Narang (1975) in a trial involving three soybean cultivars reported that cultivar Bragg had the highest

protein content of 41.02 per cent. Variation in seed protein content of soybean seeds ranging from 29.6 to 53.3 per cent was observed by Taira et al. (1976).

Lee (1977) found that the protein content of 36 soybean varieties from Korea, Japan and U.S.A. varied from 34.4 to 50.6 per cent and was negatively correlated with oil content. Schuster and Rosselt (1977) also reported negative correlation between protein and oil content of seeds. Taira (1976) reported that early varieties had higher protein and lower oil content than late varieties.

Schuster and Rosselt (1977) in a varietal trial at three different sites observed that site had greater influence on protein content than varieties.

Sood et al. (1980) in a study involving 30 promising soybean lines in Haryana observed a varietal variation of 29.37 to 40.37 per cent of protein. They also found that genotypes Ankur, PK 73-92, PK 73-84 and PK 73-94 were superior based on yield and quality.

3. Seasonal effects on oil and protein content of soybean seed

Viljoen (1937) and Weiss et al.(1950) have reported a decrease in oil content and a slight increase in protein content due to delayed planting.

Howell and Cartter (1953) observed correlation between oil percentage and maximum temperature and oil percentage and minimum temperature. They obtained highest correlation coefficient values between oil percentage and temperature during 20 to 30 and 30 to 40 days before maturity.

Higgins and Minor (1970) did not observe any variation in protein content and oil content of soybean seeds due to different planting dates. Decline in oil content due to delayed sowing was reported by Valdivia (1970).

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation was undertaken at the College of Horticulture, Vellanikkara, with a view to select soybean varieties suitable for the agroclimatic conditions of Kerala.

The experiment was conducted in the Instructional Farm attached to the College of Horticulture, Vellanikkara. The experimental site is situated at 10° 32' N latitude, 76° 16' E longitude and at an altitude of 22.25 metre above mean sea level.

Cropping history of the experimental field

Bulk crop of turmeric was grown in the previous year before which the area was occupied by rubber trees.

Soil

The soil of the experimental area is deep well drained sandy clay loam.

Data on physical and chemical characteristics of the soil are given in Table 1.

Table 1

Mechanical composition and chemical properties of soil

A. Mechanical composition

Clay	-	25.75
Silt	-	31.20
Fine sand	-	18.10
Coarse sand	-	25.15

3. Chemical properties

Constituent	Content in soil	Rating	Methods used for estimation
Total nitrogen	0.050	Medium	Micro-Kjeldahl
Available phosphorus	2.00 ppm	Low	In Bray-I extract, chlorostannous reduced molybdo-phosphoric blue colour method
Available potassium	140 ppm	High	In neutral normal ammonium acetate extract - Flame photometric
pH	4.5	Acid	1:2.5 soil:water suspension using a pH meter

Season and climate

The area enjoys a humid tropical climate.

The experiment was conducted in two seasons coinciding with the south west and north east monsoons of 1980. The first crop was raised between June 10th and October 10th and second crop was taken between October 20th and January 27th. The meteorological data for the first and second seasons are presented in Table 2 and 3 respectively and Fig. 1.

A summary of the important climatic parameters during the crop season are presented below.

Particulars	Season I	Season II
1. Weekly average of daily maximum temperature (°C) (range)	28.83 - 32.40	31.50 - 34.03
2. Weekly average of daily minimum temperature (°C) (range)	21.17 - 23.80	20.40 - 25.03
3. Relative humidity forenoon ( ) (range)	89.00 - 97.14	82.17 - 92.20
4. Relative humidity afternoon ( ) (range)	61.43 - 94.29	45.4 - 76.30
5. Total rainfall received (mm)	310.20	130.10
6. Weekly average Day length (hours) (range)	11.43 - 12.30	11.21 - 11.41

Even though the distribution of rainfall was satisfactory during the first crop season, a good amount of the rainfall was received during the first 10 weeks after sowing and for the remaining period the rainfall was low. During the second crop season the total quantity and distribution of rainfall was low and unsatisfactory and as such the crop suffered a lot due to moisture stress in the major part of the growth phase.

Seeds

The seeds of the varieties used for the trial were originally obtained from I.C.R.I. Regional Centre,

Table 2. eather data (weekly averages) for the first season (June to October 1980)

Month	Standard week	Rainfall (mm)	Temperature °C Maximum	Temperature °C Minimum	Relative humidity Forenoon	Relative humidity Afternoon	Day length (hours)
June	23	45.40	31.10	23.34	94.25	67.60	12.30
June	24	14.50	32.20	22.94	95.00	76.00	12.39
June	25	40.76	29.50	23.21	95.33	94.29	12.39
June	26	36.17	29.30	22.66	94.29	93.57	12.39
July	27	43.29	29.03	22.26	94.00	90.45	12.36
July	28	55.97	29.06	22.30	95.00	91.29	12.37
July	29	55.66	29.79	22.66	95.43	93.57	12.35
July	30	29.14	29.93	22.10	95.71	82.71	12.33
August	31	7.54	29.03	22.33	95.66	80.14	12.30
August	32	12.63	30.19	22.51	95.29	86.43	12.27
August	33	50.57	30.47	22.14	97.14	82.29	12.24
August	34	12.90	29.70	22.56	93.14	84.14	12.19
August	35	11.11	30.44	22.24	95.66	73.43	12.15
September	36	2.69	30.69	22.37	95.71	67.43	12.10
September	37	0.03	31.64	23.36	95.71	61.43	12.05
September	38	2.09	32.43	22.79	89.66	62.70	12.02
September	39	13.40	32.10	23.17	95.83	74.50	11.83
October	40	12.00	31.66	23.00	92.25	74.00	11.54
October	41	7.71	32.41	23.51	95.70	69.70	11.49
October	42	10.36	32.21	21.17	97.70	72.00	11.45

Table 3. eather data (weekly average) for the second season (October 1 to January 1)

Month	Standard week	Rainfall (mm)	Temperature °C Maximum	Minimum	Relative humidity Forenoon	Afternoon	Day length (hours)
October	43	4.71	31.50	20.65	90.90	69.70	11.41
October	44	3.23	32.00	20.57	87.30	49.63	11.37
November	45	4.03	32.75	23.03	90.50	62.[illegible]	11.33
November	46	12.74	32.00	2[illegible].57	92.20	70.90	11.29
November	47	14.23	31.60	23.11	89.10	76.30	11.26
November	48	0.00	31.75	21.90	86.10	69.90	11.24
December	49	0.00	32.07	20.63	87.60	67.40	11.22
December	50	0.00	33.04	22.64	89.90	63.70	11.21
December	51	0.00	32.29	22.54	84.70	62.40	11.21
December	52	0.00	31.90	21.30	85.20	65.10	11.21
January	1	0.00	33.53	20.40	82.70	55.10	11.24
January	2	0.00	32.86	20.47	82.10	46.00	11.26
January	3	0.00	33.14	22.09	82.90	45.40	11.28
January	4	0.00	34.03	22.30	82.60	43.10	11.29

Coimbatore during 1970. They were subjected to initial selection at the College of Horticulture, Vellanikkara. From this trial 14 varieties were found promising and were used for the present trial.

The seeds were tested for viability and were found to give satisfactory germination.

Treatments

The treatments consisted of the following 14 varieties.

1. [illegible] 39021
2. [illegible] 14437
3. [illegible] 26691
4. Improved Pollicen
5. [illegible] 92814
6. Anjur
7. [illegible]-10
8. [illegible]
9. [illegible]
10. [illegible] 39024
11. Davis
12. [illegible] 2750
13. [illegible] 65293
14. [illegible] 2506

During the first season the variety [illegible] 2506 could not be included for the trial.

Field culture

The experimental plot was ploughed with tractor, stubbles were removed, clods were broken and levelled. The field was then laid out into blocks and plots as per the experimental design. Beds of size 4.5 x 1.0 m were laid out in the plots with channels of 20 cm width in between. rovision for proper drainage was also made in the plots.

Liming and fertilizer application

Lime at the rate of 500 kg $Ca(OH)_2$ per hectare was broadcast on each bed and raked in 10 days prior to sowing. In addition, all the plots received a uniform dose of 20 kg N, 40 kg P_2O_5 and 30 kg K_2O per hectare. The entire quantity of nitrogenous, phosphatic and potassic fertilizers was applied as basal dressing.

Fertilizers used

Fertilizers with the following analysis were used for the experiment.

Ammonium sulphate	-	20% N
Superphosphate	-	16% P_2O_5
Muriate of potash	-	60% K_2O

Design and lay out

The experiment was laid out in randomised block design with 3 replications. The procedure followed for the allocation of treatments to different plots was in accordance with random number tables (Fisher and ates, 1963).

The details of the lay out are as follows:-

Number of blocks	-	3
Number of plots per block	-	13 for I crop and 14 for II crop
Number of beds per plot	-	3
Gross plot size	-	5 x 4 m
Net plot size	-	4.5 m x 3.0 m

The lay out plan is shown in Fig. 2.

Sowing

Sowings of the first and second crops were done respectively on 10th June and 20th October, 1980.

Thirty seeds were dibbled in each row of 1.0 m width at a distance of 45 cm between rows. Seedlings were thinned out a week after sowing to maintain a population of 20 plants per row, thus giving an average spacing of 5 cm between plants. The total number of plants in a bed was fixed as 200.

After cultivation

Handweeding and earthing up were done one month after sowing.

Plant protection

A mild attack of leaf eating caterpillars was noticed during the preflowering period which was effectively controlled by spraying 0.2 Sevin.

Harvesting

Maturity of the crop was decided by complete shedding of leaves. Harvesting was done by cutting the plants at the base with sickles. The varieties took 125 - 130 days for maturity in the first season while in the second season they could be harvested in 123 - 125 days.

Observations recorded

1. Growth characters

Five plants were selected at random after eliminating the border rows and all the biometric observations were recorded from these plants at various growth stages. A separate sampling area was marked for destructive sampling to record the number and weight of root nodules and for growth analysis. From the sample plants collected from this area, the different plant parts such as stem, leaves, shells and seeds were separated and used for chemical analysis subsequently.

(a) Height of plants

From the observation plants the height was measured from the base to the terminal buds and the average height worked out. This observation was taken at different growth stages.

(b) Number of branches per plant

Number of branches was counted on the observation plants at different growth stages and the averages calculated.

(c) Number of nodules per plant

This observation was taken at different growth stages commencing from 40th day. Plants were pulled out carefully after loosening the soil around them with the help of a hand fork. The total number of root nodules was counted and the average worked out.

(d) Number of effective nodules per plant

From the total number of root nodules, those with pink colour in the centre were counted separately and the averages were recorded as number of effective nodules per plant.

(e) Weight of nodules per plant

Fresh weight of the total number of nodules was taken and from this the average weight of nodules per plant was calculated.

(f) Dry matter production

After eliminating the border rows, five plants each were collected at different growth stages from the area marked for destructive sampling. The plant parts such as leaves, stems, shells and seeds were separated and their dry weights recorded separately. The total dry weight in each stage was worked out by adding the dry weight of the individual components.

(g) Leaf area index (LAI)

Leaf area was worked out by following the 'gravimetric method' (Nuti and Pelaez, 1950). Five plants were uprooted

and their leaves were separated. Ten leaves were selected at random and their outlines were traced accurately with pencil on quality bond paper of known area per unit weight. The traced portions were cut out carefully and weighed. From this, the actual area of the sample leaf was calculated.

The leaves were then dried in a hot air oven at 70 to 80° C to constant weights and the dry weights of ten leaves and the remaining leaves were recorded separately. Leaf area was then calculated using the area weight relationship and total dry weight of leaves.

LAI was calculated as follows:

$$LAI = \frac{\text{Total leaf area of five plants}}{\text{Land area occupied by five plants}}$$

(b) Net assimilation rate (NAR)

The procedure given by Watson (1958) as modified by Buttery (1970) was followed for calculating NAR. The following formula was used to arrive at the net assimilation rate.

$$NAR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1} \left(\frac{W_2 + W_1}{2} \right)$$

where,

W_2 = Total dry weight of plants m^{-2} at time t_2

W_1 = Total dry weight of plants m^{-2} at time t_1

$t_2 - t_1$ = Time interval in days

A_2 = LAI at time t_2

A_1 = LAI at time t_1

(i) Days to 50 per cent flowering

The total number of plants flowered was counted daily from five rows in each plot and the date on which 50 per cent of the plants flowered was taken as the date of flowering.

(j) Days to maturity

The number of days from sowing to harvest was taken as days to maturity.

II. <u>Post-harvest observations</u>

(a) Number of pod bearing nodes per plant

The number of pod bearing nodes was counted from the observation plants at harvest and the average worked out.

(b) Number of pods per bearing node

From the number of pods per plant and number of pod bearing nodes, the number of pods per pod bearing node was calculated.

(c) Number of seeds per pod

Twenty pods were selected at random from the observation plants, the total number of seeds counted and average worked out.

(d) 1000 seed weight

From each plot 100 seeds were taken at random, and their dry weight recorded. From this 1000 seed weight was calculated.

(e) Number of pods per plant

Average number of pods per plant was worked out by counting the total number of pods from the observation plants at harvest.

(f) Weight of pods per plant

Average weight of pods per plant was calculated by recording the weight of total number of pods from the observation plants.

(g) Shelling percentage

Shelling percentage was calculated at harvest using the following formula.

$$\text{Shelling percentage} = \frac{\text{Dry weight of seeds}}{\text{Dry weight of pods}} \times 100$$

(h) Number of seeds per plant

The total number of seeds produced in the observation plants was counted and the average worked out.

(i) Yield of seeds

The pods harvested from the net area were sundried for three days, threshed, winnowed, cleaned and the weight of clean seeds recorded. Yield was expressed as kg ha^{-1}.

(j) Yield of stover

Stover obtained from each net plot was sundried for three days and total weight was recorded. Yield was expressed in kg ha^{-1}.

(k) Harvest index

Harvest index was calculated as follows.

$$\text{Harvest index} = \frac{Y_{econ}}{Y_{biol}}$$

where,

Y_{econ} = Dry weight of seed

Y_{biol} = Total dry weight of plants

III. Content and uptake of major nutrients

A. Nitrogen, phosphorus and potassium contents of plants

Plant samples collected for recording dry weights were used for chemical analysis. The nitrogen, phosphorus and potassium contents of stem, leaves, pods, shells and seeds at different stages of plant growth were determined by using Auto analyser, Spectrophotometer (Spectronic 20) and U.V. Flame Photometer (Jackson, 1958).

B. Uptake of nutrients

The total uptake of nitrogen, phosphorus and potassium by the plant and individual plant parts were calculated at different stages of growth from the nutrient content and dry weights of plant parts.

IV. Quality characters

(a) Protein content of seeds

The protein content of seeds was calculated by multiplying the nitrogen content of seeds with the factor 6.25 (A.O.A.C., 1955).

(b) Protein yield

The protein yield was calculated from the protein

content of seeds and total seed yield and expressed in kg ha^{-1}.

(c) Oil content of seeds

The oil content of oven dried seeds was estimated by using Soxhlet apparatus (A.O.C.S., 1971) and expressed as percentage.

(d) Oil yield

The oil yield was estimated from the oil content of seeds and total yield of seeds and expressed as kg ha^{-1}.

V. Statistical analysis

Data were analysed statistically by employing the analysis of variance technique as suggested by Cochran and Cox (1965). Simple and multiple linear correlation coefficients between yield and growth characters and yield and yield contributing characters were worked out as per the techniques suggested by Snedecor and Cochran (1967).

The characters which were significantly correlated with yield, were selected for forming the multiple linear regression equation (selection index) as a basis for selecting superior varieties. It was of the form

$$Y = b_0 + \sum_{i=1}^{n} b_i x_i$$

n = number of quantitative characters

b_0 = a constant

Y = yield per plant

b_i = the partial regression coefficient of Y on x_i

x_i = the mean value of the i^{th} character

The coefficient of determination was also calculated to know the percentage variation explained by the regression equation. The partial regression coefficients were tested for significance using the Student's 't' test.

The independent variates of the regression function were replaced by their mean values for each variety to get an index score. This index score was used to assess the genetic worth of the material. The varieties were ranked according to these indices in the order of their magnitude and the promising varieties were identified.

Another method of selecting superior genotypes for further propagation was adopted on the assumption that the distribution of yield plot^{-1} was normal.

According to this criterion those varieties which fell in the upper 5 per cent portion of the fitted normal curve were designated as superior.

RESULTS

RESULTS

Results of the experiment "Comparative performance of soybean varieties" are presented below.

A. Growth characters

(a) Height of plant

The data on mean height of plants at various growth stages are presented in Table 4 and the analysis of variance in Appendix 1.

There was no significant varietal difference in plant height at any of the stages of plant growth in both the seasons. All the 14 varieties tried in this experiment showed more or less comparable plant height.

Plant height in the second season was considerably lower in all the varieties. For example the variety JN 2750 which recorded the highest plant height of 70.27 cm during the first season could record a plant height of 24.21 cm only during the second season.

(b) Number of branches per plant

The data on the number of branches per plant at various growth stages are presented in Table 4 and the analysis of variance in Appendix 1.

This observation was taken only in the first season and there was no significant difference in the number of branches per plant between varieties.

Table 4. Height of plant and number of branches per plant at different growth stages of soybean varieties in the two seasons

Treatments	Height of plants (cm)					Number of branches per plant	
	First season			Second season		First season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	28.94	41.88	62.63	11.18	20.01	1.66	4.90
2. EC 14437	28.10	39.37	57.61	12.16	19.42	1.86	4.48
3. EC 26691	26.02	44.63	66.20	12.78	20.03	1.80	5.67
4. Improved Pelican	31.42	36.23	59.53	13.88	22.89	1.20	4.57
5. EC 92814	28.18	40.65	62.73	11.90	20.73	1.80	4.33
6. Ankur	31.37	40.87	59.81	11.47	19.40	1.53	4.83
7. PLS0-16	28.70	36.72	58.96	11.77	19.92	0.60	4.48
8. Monette	26.78	39.93	66.88	11.57	20.79	1.06	4.37
9. Bragg	29.19	43.80	64.31	12.90	22.41	1.40	4.20
10. EC 39824	26.03	39.03	60.09	12.33	23.00	0.93	3.67
11. Davis	27.14	40.37	58.45	12.08	18.45	1.01	4.43
12. JN 2750	30.01	48.30	70.27	14.63	24.21	2.46	5.10
13. EC 63298	26.62	38.20	59.95	13.84	24.26	1.46	4.17
14. EC 2586				12.33	24.65		
F test	NS	NS	NS	NS	NS	NS	NS
SEm ±	2.534	3.694	5.070	1.025	1.672	0.403	0.597
C.D. 5%	-	-	-	-	-	-	-

(c) Number of root nodules per plant

The data on the number of root nodules per plant at various stages of plant growth are presented in Table 5 and the analysis of variance in Appendix 2.

The number of root nodules per plant did not differ significantly between varieties in both the seasons.

Comparison between stages in the first season indicated a gradual increase in the number of root nodules per plant upto 90th day. It was also noticed that the rate of production of root nodule was highest between 60th and 90th day. No consistent variation in the number of root nodules per plant between stages was noticed in the second season.

The number of root nodules per plant in the second season was considerably lower.

(d) Number of effective nodules per plant

The data on the number of effective nodules per plant are presented in Table 6 and the analysis of variance in Appendix 2.

The data revealed that there was no significant difference in the number of effective nodules per plant among varieties in both the seasons.

The number of effective nodules per plant was markedly less in the second season as compared to the first season.

Table 5. Total number of nodules per plant at different growth stages of soybean varieties in the two seasons.

Treatments	Number of nodules per plant				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	0.522(1.000)	0.979(2.428)	10.106(10.076)	1.007(3.327)	0.277(1.943)
2. EC 14437	0.326(1.6212)	2.006(3.321)	18.399(9.643)	0.0993(1.412)	0.178(1.667)
3. EC 26691	0.182(1.382)	2.352(3.572)	12.265(7.895)	0.265(1.911)	0.144(1.715)
4. Improved Pelican	0.496(2.865)	3.779(4.460)	10.173(7.202)	0.458(2.364)	0.728(2.876)
5. EC 92814	0.759(2.190)	2.009(3.323)	10.293(7.243)	0.461(2.370)	0.536(2.523)
6. Ankur	0.844(2.285)	2.440(3.633)	5.199(5.196)	0.428(2.298)	0.899(3.160)
7. PLS0-18	0.298(1.577)	1.081(2.531)	26.829(11.624)	0.776(2.961)	0.916(3.189)
8. Monetta	2.719(3.820)	4.087(4.629)	6.630(5.844)	0.892(3.150)	0.416(2.270)
9. Bragg	1.596(2.996)	4.310(4.748)	26.079(11.463)	0.116(1.471)	0.300(2.000)
10. EC 39824	0.979(2.428)	5.900(5.413)	27.589(11.788)	0.672(2.778)	0.549(2.548)
11. Davis	0.854(2.296)	8.378(6.549)	6.640(5.848)	0.149(1.577)	0.333(2.081)
12. JH 2750	2.511(3.681)	3.619(4.390)	22.349(10.618)	0.284(1.959)	0.198(1.727)
13. EC 63298	1.188(2.634)	5.956(5.548)	12.505(7.970)	1.362(3.823)	0.519(2.490)
14. EC 2586				0.003(1.130)	0.177(1.667)
F test	NS	NS	NS	NS	NS
SEm±	0.121	0.362	0.377	0.140	0.164
C.D. at 5%	-	-	-	-	-

Figures in parenthesis indicate $\sqrt{(x+1)}$ transformed value

Table 6. Number of effective nodules and weight of nodules per plant at different growth stages of soybean varieties in the two seasons

Treatments	Number of effective nodules			Weight of nodules per plant (g)			
	First season	Second	Second season	First season			Second season
	60th day after sowing	90th day after sowing	60th day after sowing	40th day after sowing	60th day after sowing	90th day after sowing	60th day after sowing
. EC 39821	0.329(1.626)	4.020(4.595)	0.000(1.000)	0.023(1.057)	0.052(1.125)	0.517(1.093)	0.001 (1.006)
. EC 14437	0.491(1.859)	4.943(5.071)	0.000(1.000)	0.033(1.080)	0.059(1.139)	0.229(1.464)	0.0002(1.001)
. EC 26691	0.771(2.203)	6.688(5.869)	0.000(1.000)	0.013(1.083)	0.155(1.333)	0.483(1.849)	0.0001(1.001)
. Improved pelican	2.044(3.350)	6.859(5.941)	0.055(1.244)	0.028(1.067)	0.165(1.352)	0.187(1.391)	0.003(1.012)
. EC 92814	0.600(2.000)	4.156(4.667)	0.198(1.727)	0.068(1.158)	0.103(1.231)	0.383(1.707)	0.001(1.006)
. Ankur	0.498(1.869)	3.644(4.384)	0.607(2.661)	0.067(1.155)	0.065(1.152)	0.170(1.360)	0.008(1.038)
. PLS0-18	0.199(1.412)	8.379(6.550)	0.091(1.382)	0.014(1.034)	0.036(1.087)	0.456(1.811)	0.006(1.029)
. Manetta	0.617(2.021)	3.197(4.121)	0.100(1.414)	0.134(1.293)	0.113(1.252)	0.383(1.707)	0.0007(1.003)
. Bragg	1.457(2.879)	6.154(5.637)	0.055(1.244)	0.115(1.254)	0.280(1.549)	0.654(2.067)	0.001(1.006)
0. EC 39824	1.944(3.274)	0.992(2.441)	0.233(1.824)	0.836(1.191)	0.376(1.697)	0.781(2.215)	0.002(1.009)
1. Davis	1.839(3.193)	3.988(4.576)	0.185(1.687)	0.046(1.110)	0.186(1.389)	0.129(1.283)	0.005(1.008)
2. JN 2750	1.498(2.914)	5.927(5.535)	0.099(1.412)	0.128(1.282)	0.316(1.606)	0.641(2.050)	0.001(1.006)
3. EC 63298	1.448(2.871)	5.994(5.565)	0.222(1.794)	0.064(1.148)	0.286(1.559)	0.162(1.345)	0.003(1.013)
4. EC 2586			0.055(1.244)				0.0003(1.001)
F test	NS	NS	NS	NS	NS	NS	NS
SEm ±	0.175	0.374	0.047	0.015	0.037	0.045	0.0014
C.D. at 5%	-	-	-	-	-	-	-

Figures in parenthesis indicate $\sqrt{(x+1)}$ transformed value

(e) Weight of root nodules per plant

Data on the weight of root nodules per plant at different growth stages are presented in Table 6 and the analysis of variance in Appendix 2.

The varieties did not show any significant difference in the weight of root nodules per plant in both the seasons.

Comparison between stages in the first season indicated a gradual increase in the weight of root nodules per plant upto 90th day.

As in the case of number of root nodules per plant, weight of root nodule per plant was also drastically less in second season as compared to first season in all the varieties.

(f) Total phytomass production per plant

The data on total phytomass production per plant at different growth stages are presented in Table 7.

The analysis of variance is given in Appendix 3.

Varieties did not show any significant difference in the total phytomass production per plant in both the seasons.

It was also noticed that there was a gradual increase in the total phytomass production upto 90th day and a decline thereafter in all the varieties in the first season. But during the second season a steady increase in phytomass production was noticed throughout the crop growth period.

Table 7. Total phytomass production per plant at different growth stages of soybean varieties in the two seasons.

Treatments	Total phytomass production per plant (g)						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	1.771	3.587	17.503	14.533	0.358	0.721	1.031.
2. EC 14437	1.603	4.785	17.917	10.500	0.364	0.873	1.150
3. EC 26691	1.133	5.090	18.439	18.200	0.423	0.950	1.126
4. Improved Pelican	2.104	6.224	22.315	19.047	0.403	1.154	1.394
5. EC 92814	1.925	5.893	16.756	14.860	0.369	1.401	1.334
6. Ankur	2.132	3.618	17.533	10.833	0.291	0.933	1.174
7. PLS0-18	2.085	3.577	14.557	11.867	0.469	1.084	1.419
8. Manette	1.635	4.779	16.039	16.033	0.581	0.709	1.186
9. Bragg	1.541	5.237	24.738	21.633	0.430	0.830	1.181
10. EC 39824	1.847	4.837	22.148	16.047	0.404	0.953	1.034
11. Davis	1.380	5.804	18.558	15.147	0.474	0.939	0.933
12. JS 2750	1.233	6.217	21.621	21.333	0.305	1.051	1.566
13. EC 63298	1.868	4.760	14.092	12.540	0.386	1.158	1.265
14. EC 2586					0.395	0.775	1.852
F test	NS	NS	NS	NS	NS	NS	NS
SEm±	0.391	1.450	3.130	3.243	0.0877	0.2433	0.169
C.D. at 5%	-	-	-	-	-	-	-

FIG.3. VARIETAL VARIATION ON TOTAL DRYMATTER PRODUCTION PER PLANT AT HARVEST

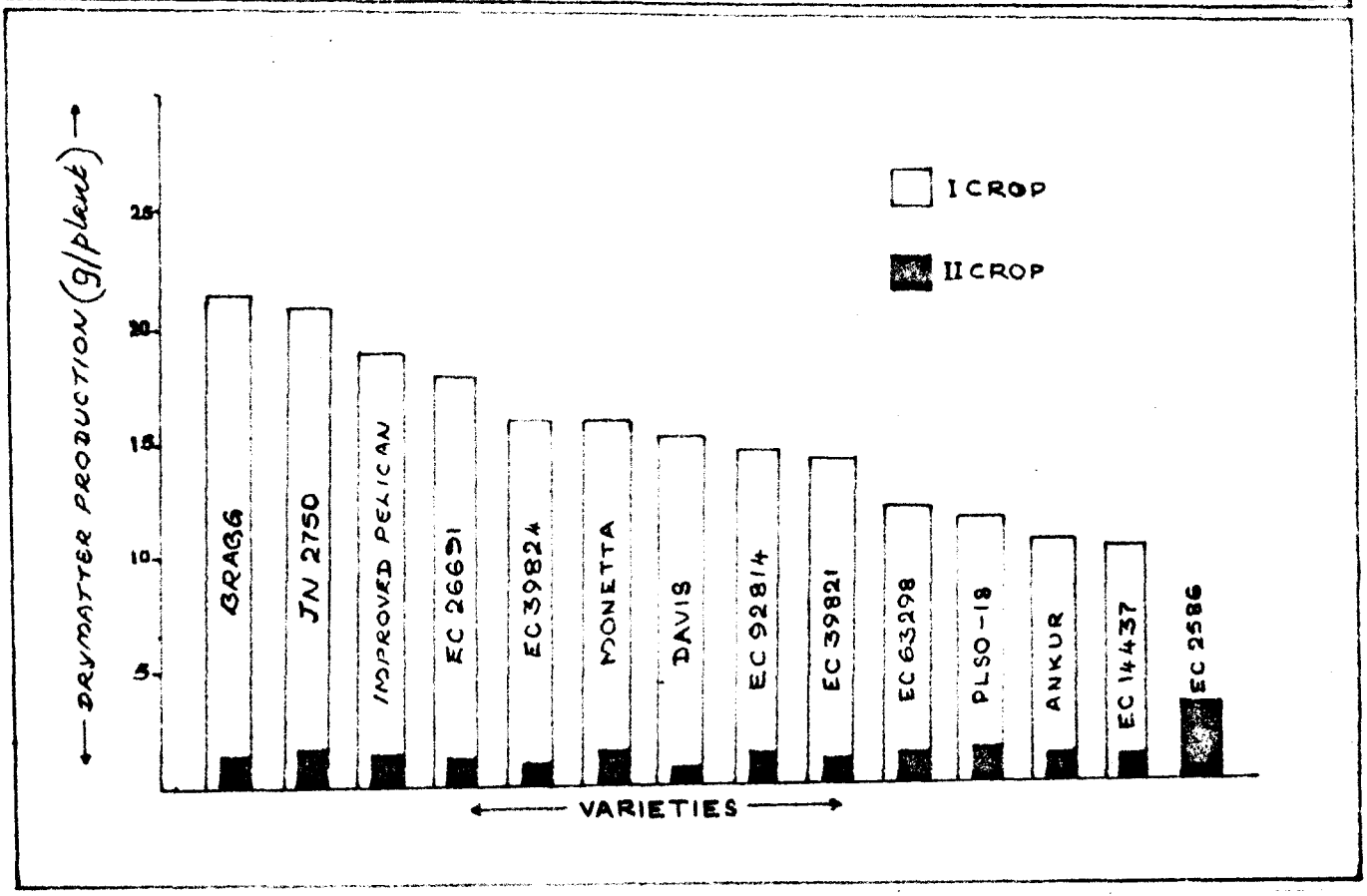
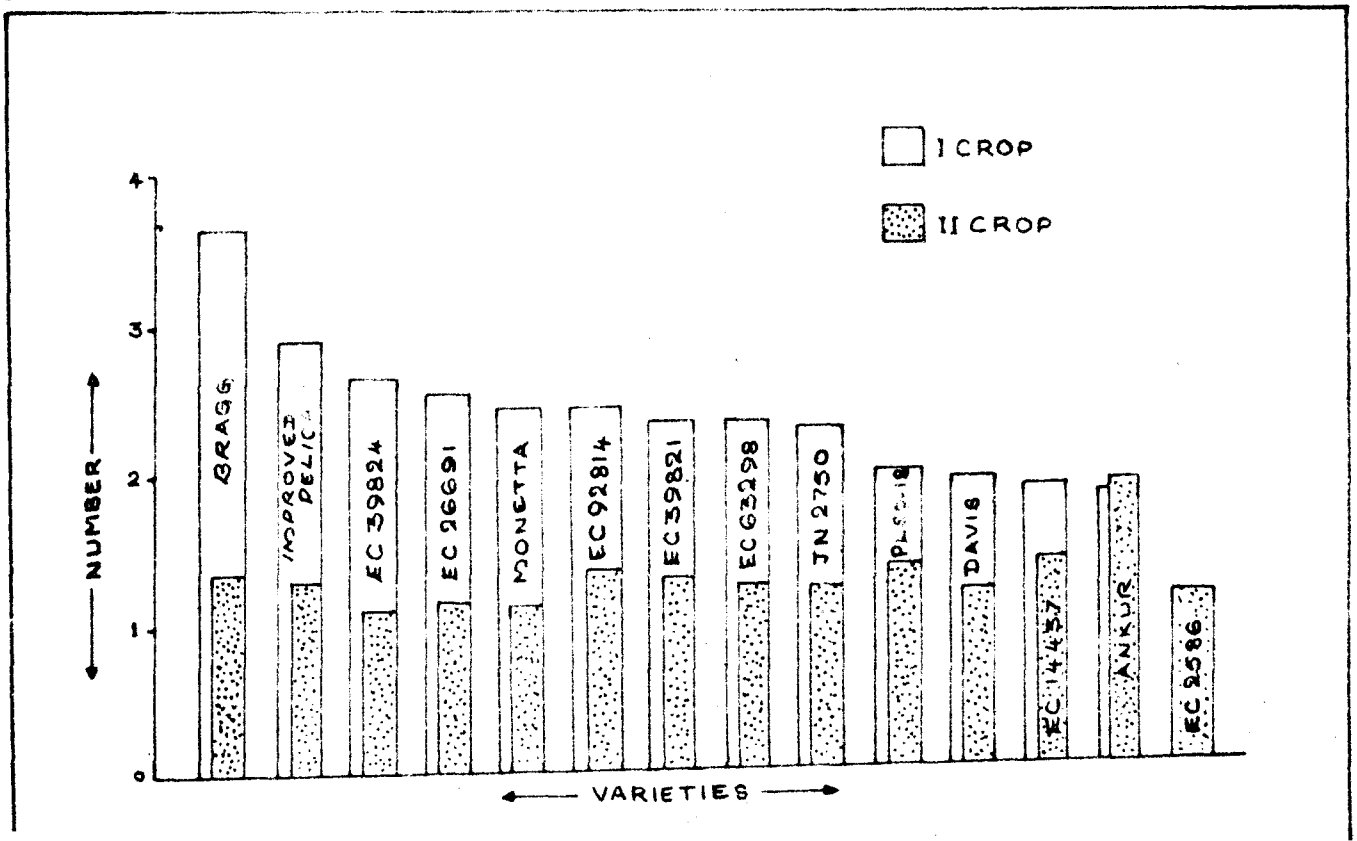


FIG.4. VARIETAL VARIATION ON NUMBER OF PODS PER BEARING NODE



A drastic decline in total phytomass production was noticed in the second season compared to first in all the varieties studied. For example the variety Bragg which recorded the highest dry weight value of 21.633g plant^{-1} during first season could produce only a total phytomass of 1.181g plant^{-1} during second season.

(g) Leaf area index

The results on the leaf area index at various stages of plant growth are presented in Table 8 and the analysis of variance in Appendix 4.

The data revealed that the varieties did not differ significantly with respect to leaf area index on 40th and 60th days in both the seasons. But in the first season, there was significant difference in LAI on 90th day after sowing. At this stage the variety JN 2750 recorded the highest LAI of 8.094 which was on par with Improved Pelican, EC 39824, Bragg, EC 26691, Davis, EC 39821, EC 92814 and Ankur. All the varieties except EC 14437 recorded highest LAI values on 90th day after sowing during this season. It was also noticed that the varieties in general recorded the highest LAI values on 90th day in the first season and on 60th day in the second season.

A comparison between seasons showed that the LAI of all the varieties was less in the second season.

Table 8. Leaf area index and net assimilation rate at different growth stages of soybean varieties in the two seasons

Treatments	Leaf area index					Net assimilation rate (gm^{-2} day^{-1})		
	First season			Second season		First season		Second season
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing	Between 40th & 60th day after sowing	Between 60th & 90th day after sowing	40th and 60th day after sowing
1. EC 39821	1.604	2.877	5.842	0.419	0.677	2.308	4.293	1.278
2. EC 14437	1.279	2.785	2.317	0.481	0.776	4.259	2.526	1.632
3. EC 26691	0.824	3.842	6.054	0.613	0.900	3.699	4.475	1.523
4. Improved Pelican	1.774	3.531	8.076	0.493	1.144	5.441	3.092	2.407
5. EC 92814	1.556	4.071	5.336	0.471	1.053	4.242	3.815	2.942
6. Anbur	1.631	2.460	5.211	0.366	0.857	2.106	4.401	1.971
7. PL80-18	1.478	2.386	4.152	0.623	0.957	2.583	5.445	1.616
8. Monetta	1.335	3.111	4.144	0.798	0.658	4.180	4.510	0.823
9. Bragg	1.247	4.286	7.767	0.550	0.766	3.165	4.729	1.412
10. EC 39824	1.593	3.861	7.792	0.574	0.925	2.961	3.727	1.962
11. Davis	1.161	4.304	5.874	0.580	0.744	3.951	5.225	1.402
12. JN 2750	1.152	5.024	8.094	0.461	0.980	4.523	3.877	2.036
13. EC 63298	1.525	3.214	4.115	0.506	0.960	3.920	2.843	2.326
14. EC 2586				0.458	0.866			1.543
F test	NS	NS	S	NS	NS	NS	NS	NS
SEm±	0.315	1.012	1.069	0.125	0.228	1.118	1.013	0.506
C.D. at 5%	-	-	3.120	-	-	-	-	-

(h) Net assimilation rate

The data on net assimilation rate between growth stages are presented in Table 8 and the analysis of variance in Appendix 4.

It can be seen from the Table 8 that there was no significant difference in net assimilation rate between varieties at any of the stages of plant growth in both the seasons.

A comparison of the trend in NAR between 40th and 60th day and 60th and 90th day showed an increase in NAR in 8 of the varieties under test, while the remaining ones showed a decreasing trend.

As in the case of LAI and other characters, a considerable reduction in NAR was also observed in the second season compared to first.

(i) Number of days to flowering

Data on number of days to flowering are given in Table 9.

The varieties took 56 to 62 days for flowering in the first season and 45 to 53 days in the second season.

(j) Number of days to maturity

The data on the number of days to maturity are given in Table 9.

The varieties took 125 to 130 days for maturity in the first season and 83 to 85 days in the second season.

Table 9. Number of days to flowering and number of days to maturity of soybean varieties in the two seasons

Treatments	Days to 50 per cent flowering		Days to maturity	
	First season	Second season	First season	Second season
1. EC 39821	60	52	129.5	83.5
2. EC 14457	62	52	128.5	84.0
3. EC 26691	58	48	126.5	84.5
4. Improved Pelican	57	47	126.5	83.0
5. EC 92814	58	53	128.0	84.0
6. Ankur	59	50	129.5	84.0
7. PL80-18	58	50	129.5	85.0
8. Hamette	57	50	126.5	85.0
9. Bragg	56	47	125.0	85.0
10. EC 39824	58	50	130.0	83.0
11. Davis	58	50	129.5	83.5
12. JN 2750	58	48	126.0	84.5
13. EC 63298	58	45	126.5	83.0
14. EC 2586		50		83.0

II. Observations at harvest

(a) Number of bearing nodes per plant

The data on the number of bearing nodes per plant at harvest are presented in Table 10 and the analysis of variance in Appendix 5.

Varieties did not show any significant difference on the number of bearing nodes per plant in both the seasons.

The number of bearing nodes per plant was much less in the second season.

(b) Number of pods per bearing node

The data on the number of pods per bearing node are given in Table 10 and Fig.4. The analysis of variance is given in Appendix 5.

There was significant varietal difference in the number of pods per bearing node in the first season. The variety Bragg recorded the highest number of pods per bearing node (3.68) which was on par with Improved Pelican but superior to all other varieties.

The number of pods per bearing node also was considerably less in second season.

(c) Number of seeds per pod

The mean values on the number of seeds per pod are presented in Table 10 and Fig.5. The analysis of variance is in Appendix 5.

The varieties did not show any significant variation in the number of seeds per pod in both the seasons.

Table 10. Number of bearing nodes per plant, number of pods per bearing node, number of seeds per pod and 1000-seed weight of soybean varieties in the two seasons.

Treatments	Number of bearing nodes per plant		Number of pods per bearing node		Number of seeds per pod		1000 seed weight (g)	
	First Season	Second season	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	19.20	4.67	2.36	1.28	1.78	0.82	86.67	66.73
2. EC 14437	18.27	3.60	1.90	1.41	1.75	1.19	79.96	65.12
3. EC 26691	24.20	4.07	2.50	1.14	1.71	1.10	85.40	70.90
4. Improved pelican	20.27	4.60	2.90	1.28	1.62	1.00	87.21	70.30
5. EC 92814	18.53	3.67	2.44	1.36	1.88	1.93	89.59	68.10
6. Ankur	17.60	3.87	1.85	1.91	1.71	1.07	84.84	70.57
7. PLS0-18	15.60	4.00	1.99	1.39	1.94	1.73	83.90	72.29
8. Monetta	20.47	4.07	2.45	1.13	1.82	1.42	84.05	68.53
9. Bragg	19.00	4.13	3.68	1.34	1.77	1.39	84.36	65.77
10. EC 39824	19.40	3.93	2.67	1.08	1.65	1.57	82.71	61.00
11. Davis	18.67	3.80	1.96	1.21	1.83	0.87	89.23	64.37
12. JN 2750	25.47	5.33	2.30	1.23	1.67	1.66	86.07	67.68
13. EC 63298	16.93	4.80	2.35	1.26	1.87	1.18	83.60	66.61
14. EC 2586		4.27		1.16		2.02		70.30
F Test	NS	NS	S	NS	NS	NS	NS	NS
SEm±	3.344	0.570	0.287	0.171	0.105	0.293	0.207	0.272
C.D. at 5%	-	-	0.838	-	-	-	-	-

FIG. 5. VARIETAL VARIATION ON NUMBER OF SEEDS PER POD

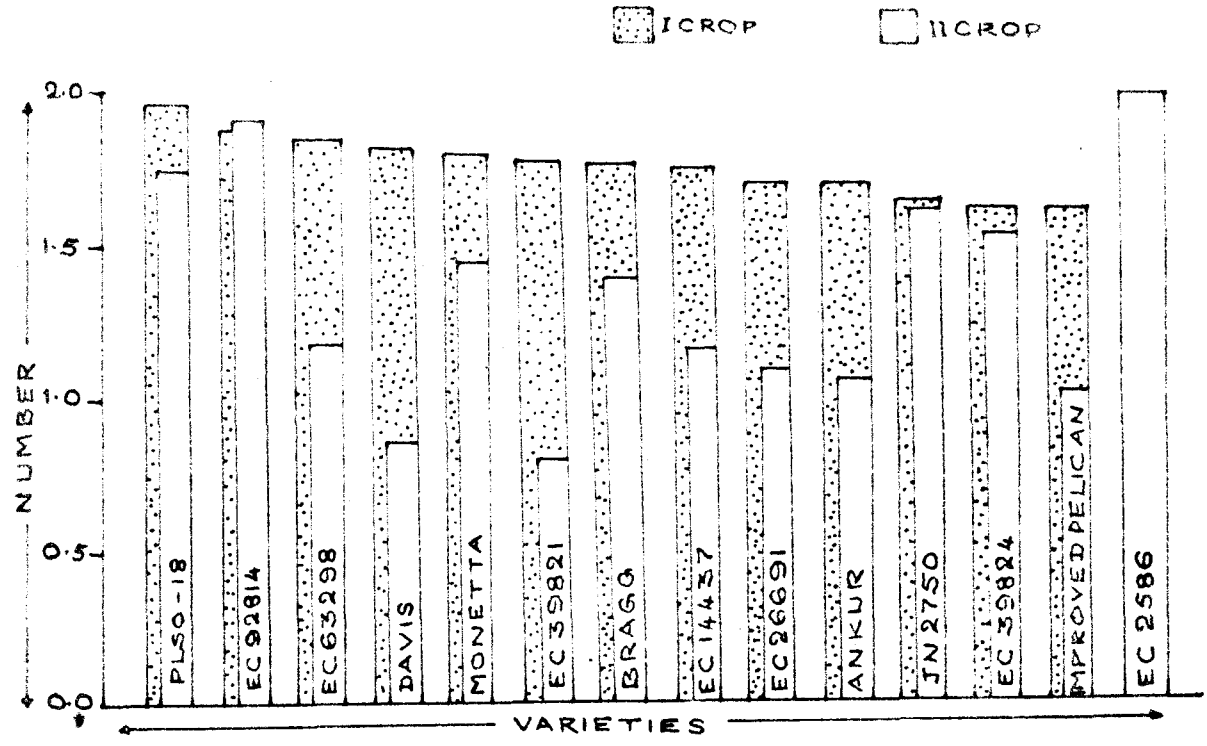
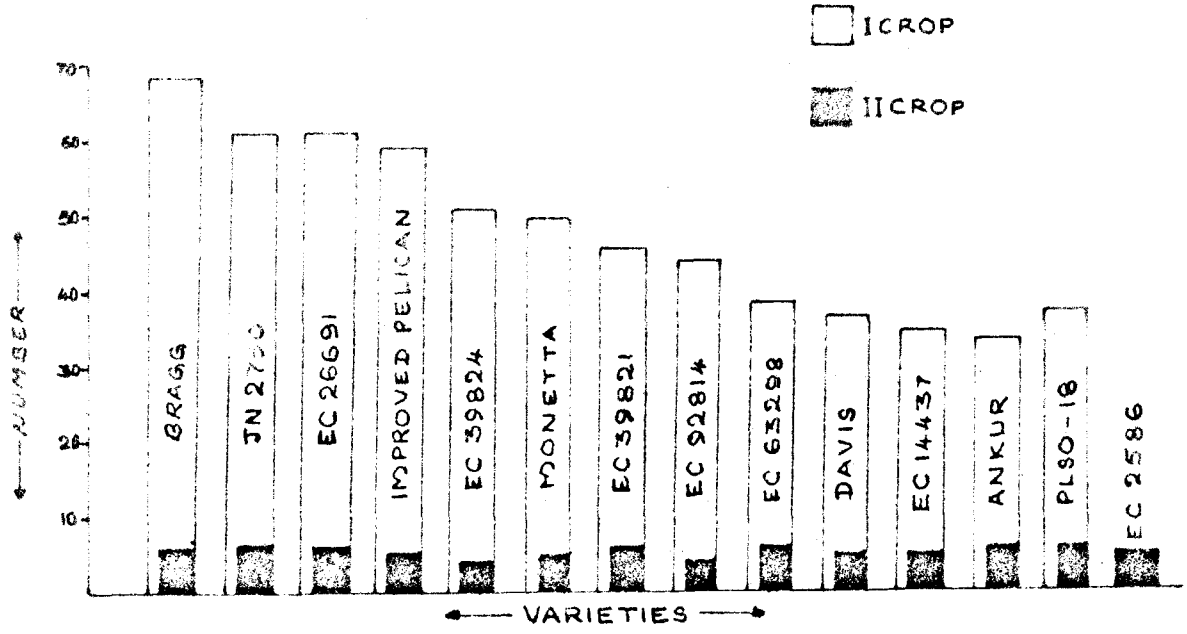


FIG. 6. VARIETAL VARIATION ON NUMBER OF PODS PER PLANT



Like other growth and yield characters, the number of seeds per pod also was less in the second season.

(d) 1000-seed weight

Data on 1000 seed weight are presented in Table 10 and the analysis of variance in Appendix 5.

There was no significant varietal difference in 1000-seed weight among the varieties tested in both the seasons.

But a considerable reduction in test weight was noticed between seasons.

(e) Number of pods per plant

The data on the number of pods per plant are presented in Table 11 and Fig.6. The analysis of variance is given in Appendix 6.

There was no significant difference in number of pods per plant between varieties in both the seasons.

But there was a very heavy decline in the number of pods in the second season.

(f) Weight of pods per plant

The data on the weight of pods per plant are presented in Table 11 and Fig.7. The analysis of variance in Appendix 6.

It can be seen from the table that the varieties did not show any significant difference in the weight of pods per plant.

As in the case of number of pods per plant the mean

Table 11. Number of pods per plant, weight of pods per plant, shelling percentage and number of seeds per plant of soybean varieties in the two seasons

Treatments	Number of pods per plant		Weight of pods per plant (g)		Shelling percentage		Number of seeds per plant	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	46.33	6.07	10.05	0.61	62.78	54.10	82.90	4.30
2. EC 14437	35.06	4.93	7.17	0.73	57.73	54.92	62.34	5.87
3. EC 26691	60.73	5.80	13.10	0.73	58.92	53.03	107.97	6.40
4. Improved Pelican	58.90	5.67	12.93	0.84	58.51	57.32	96.87	5.80
5. EC 92814	44.67	4.40	10.66	0.99	61.88	53.17	84.27	8.67
6. Ankur	33.73	6.50	7.00	0.82	64.06	55.14	56.80	6.90
7. PL80-18	30.67	5.60	7.90	1.05	58.17	58.30	59.93	8.37
8. Monetta	49.87	4.60	11.23	0.77	61.79	53.53	90.87	6.53
9. Bragg	68.47	5.73	14.56	0.69	61.69	53.19	121.73	6.50
10. EC 39824	51.33	4.23	11.00	0.57	62.05	52.24	85.53	6.03
11. Davis	36.80	4.60	9.38	0.61	65.97	52.10	67.13	3.93
12. JN 2750	60.73	6.53	14.10	1.08	61.63	54.55	117.67	10.67
13. EC 63298	39.73	6.07	8.81	0.80	61.28	53.93	67.67	7.13
14. EC 2586		5.30		1.36		56.86		10.50
F test	NS	NS	NS	NS	S	S	NS	S
SEm±	9.910	0.705	2.291	0.163	1.413	1.005	18.466	1.186
C.D. at 5%	-	-	-	-	4.123	3.096	-	3.448

FIG.7. VARIETAL VARIATION ON WEIGHT OF PODS PER PLANT

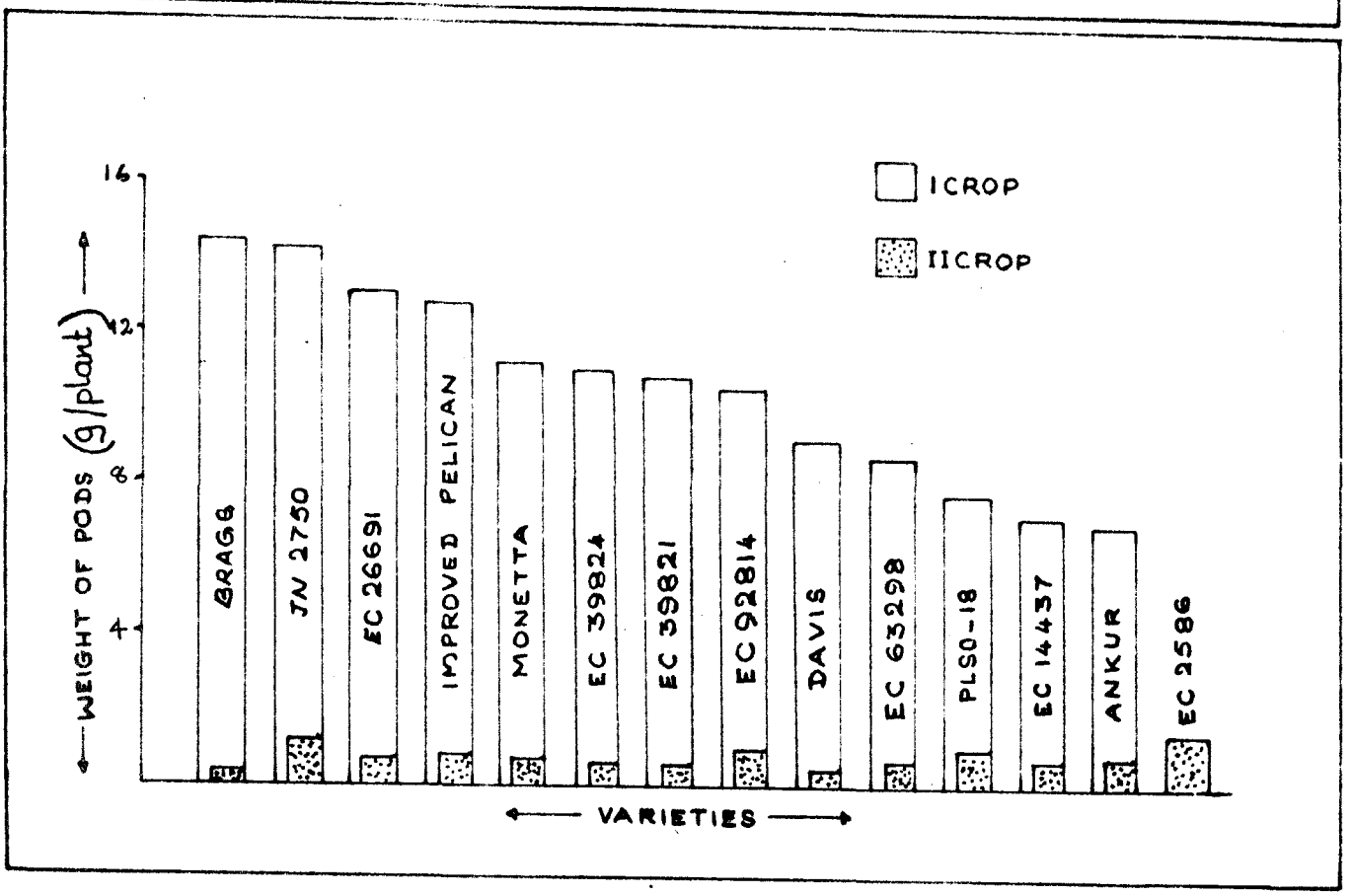
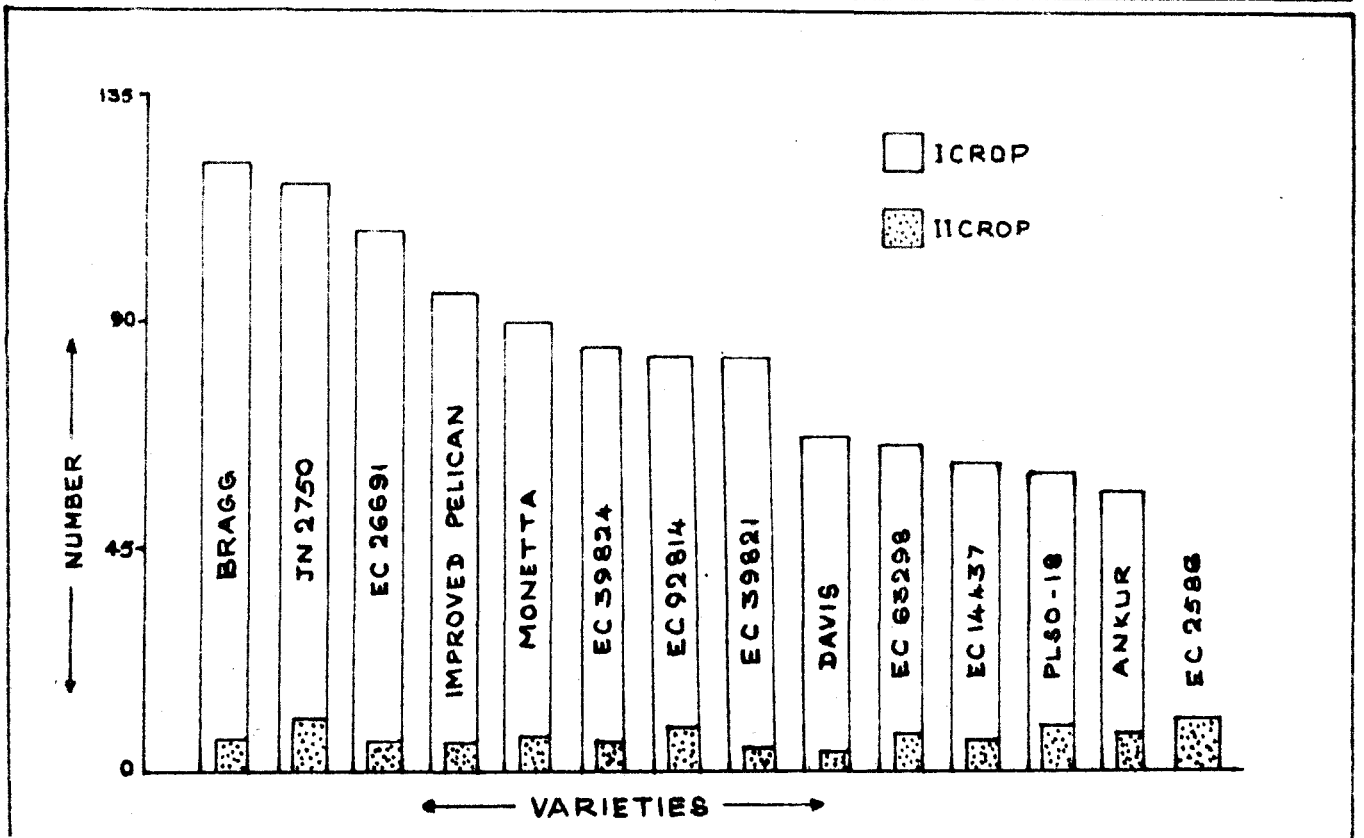


FIG.8. VARIETAL VARIATION ON NUMBER OF SEEDS PER PLANT



weight of pods per plant was markedly lower during the second season.

(g) Shelling percentage

Data on shelling percentage are presented in Table 11 and the analysis of variance in Appendix 6.

There was significant varietal difference on shelling percentage in both the seasons. The variety Davis recorded highest shelling percentage of 65.97 during the first season and this was on par with Ankur, EC 39821, EC 39824 and EC 92814.

During the second season cultivar PLSO-18 gave the highest shelling percentage (58.30) which was on par with Improved Pelican and EC 2586 but superior to all other varieties.

A general decline in shelling percentage was also noticed in the second season compared to the first.

(h) Number of seeds per plant

Data on the number of seeds per plant are presented in Table 11 and Fig.8. The analysis of variance is given in Appendix 6.

There was significant varietal difference in the number of seeds per plant only in the second season and the variety JL 2750 recorded the highest value. It was on par with EC 2586, EC 92814 and PLSO-18. The number of seeds per plant again was less during second season than the first.

(1) Yield of seed

Data on yield of seeds are presented in Table 12 and Fig.9 and analysis of variance in Appendix 7.

There was significant varietal difference with respect to this character.

During the first season, the variety Bragg, recorded the highest yield of 2319.49 kg ha^{-1} and it was on par with the varieties EC 26691, JN 2750, EC 63298, Monetta, Improved Pelican, EC 39824, EC 39821, Davis and Ankur, but superior to EC 92814, EC 14437 and ALSO 18.

For selecting out a few superior varieties a critical value of discrimination at 95 per cent confidence was determined assuming the normality of plot yields and this was found to be 2096.66. Using this critical level the varieties Bragg, EC 26691, JN 2750, EC 63298 and Monetta were selected as promising in the relative order of magnitude.

Correlation between yield and yield contributing and growth characters

The simple correlation coefficients of different growth and yield components with yield are presented in Table 12(a). It was observed that the yield contributing factors such as number of seeds per plant, number of pods per plant, weight of pods per plant, number of bearing nodes per plant and number of pods per bearing node showed significant positive correlation with seed yield.

Table 12. Yield of seeds, yield of stover and harvest index of soybean varieties in the two seasons

Treatments	Yield of seed (kg ha^{-1})		Yield of stover (kg ha^{-1})		Harvest index	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	2072.57	107.57	2974.20	195.36	0.384	0.367
2. EC 14437	1412.22	109.08	2095.03	178.01	0.382	0.370
3. EC 26691	2244.67	78.63	3217.37	154.60	0.410	0.383
4. Improved Pelican	2080.52	123.28	3616.45	198.13	0.403	0.364
5. EC 92814	1833.14	68.05	2543.97	152.56	0.418	0.292
6. Ankur	1915.45	97.71	2674.91	172.08	0.416	0.382
7. PLS0-18	1338.02	129.00	2250.69	169.70	0.382	0.455
8. Monetta	2121.21	111.98	2731.03	206.80	0.439	0.372
9. Bragg	2319.49	74.65	3477.93	173.90	0.400	0.320
10. EC 39824	2080.06	63.90	3329.61	161.58	0.383	0.301
11. Davis	1922.93	75.62	2731.62	163.20	0.415	0.344
12. JN 2750	2222.22	115.50	3497.96	197.00	0.388	0.353
13. EC 63298	2169.85	115.95	2974.20	184.93	0.412	0.355
14. EC 2506		128.93		201.73		0.376
F test	S	S	S	S	NS	NS
SEm ±	147.400	11.760	183.640	9.583	0.014	0.028
C.D. at 5%	430.470	35.168	535.228	40.018	-	-

FIG.9. VARIETAL VARIATION ON SEED YIELD

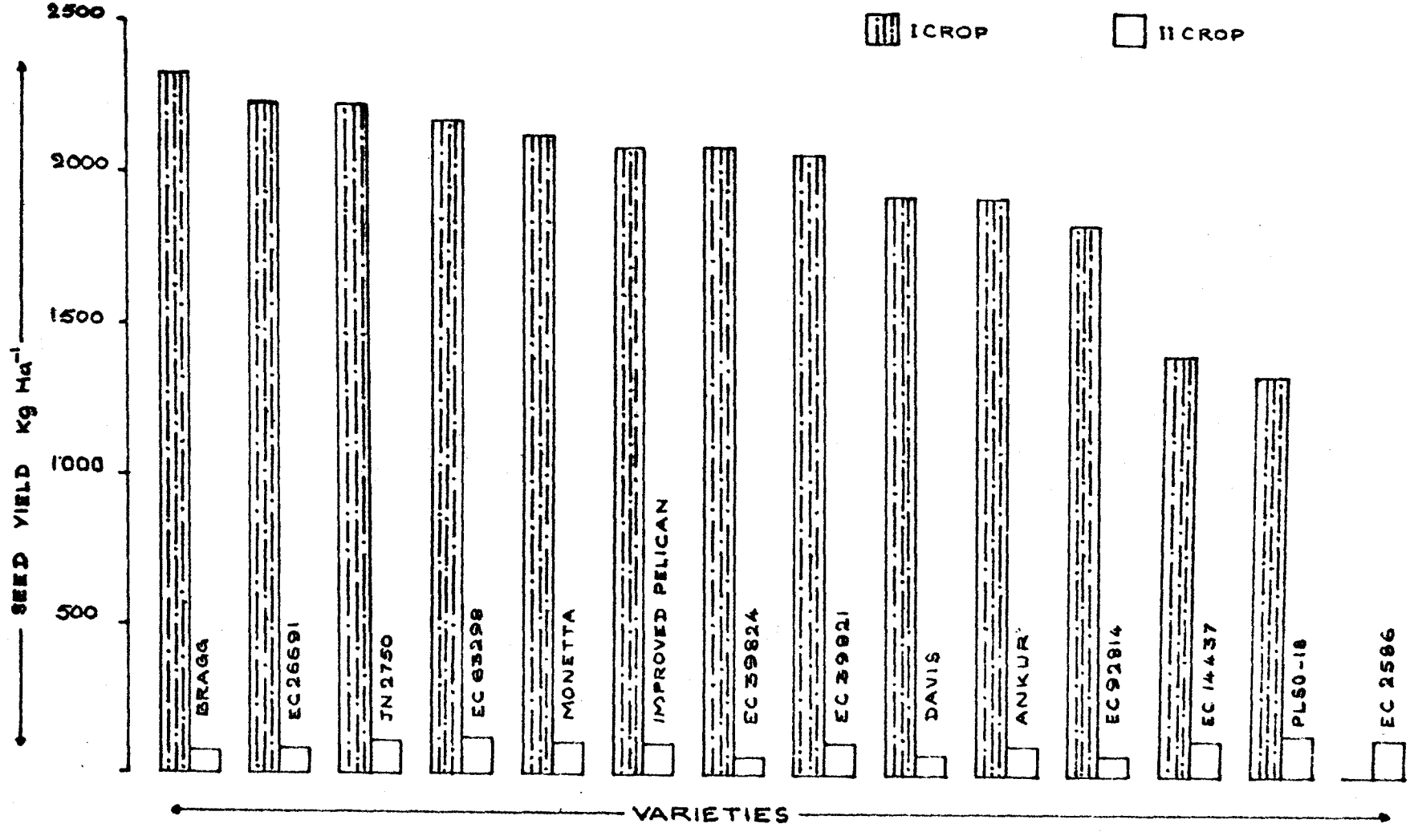


Table 12(a). Simple linear correlation coefficients of yield per plant with different quantitative characters.

1.	Number of seeds per plant	0.9714**
2.	Number of pods per plant	0.9321**
3.	Weight of pods per plant	0.9943**
4.	Number of seeds per pod	0.2474
5.	Number of bearing nodes per plant	0.8043**
6.	Number of pods per bearing node	0.5679**
7.	1000 seed weight	0.2486
8.	Height at 40th day	0.06013
9.	Height at 60th day	0.3074
10.	Height at 90th day	0.2400
11.	Number of branches per plant at 40th day	0.0573
12.	Number of branches per plant at 60th day after sowing	-0.0284

** Significant at 1% level

Table 12(b). Correlation matrix of number of pods per bearing node, number of bearing nodes per plant and seed weight per plant.

	y	x_1	x_2
y	1.000		
x_1	0.568	1.000	
x_2	0.804	0.1270	1.000

y = Seed weight per plant

x_1 = Number of pods per bearing node

x_2 = Number of bearing nodes per plant

It was also found that of the four independent factors viz., number of bearing nodes per plant, number of pods per bearing node, number of seeds per pod, and teot weight the simple correlation coefficients between yield and yield contributing factors was significant only for the number of bearing nodes per plant and number of pods per bearing node. Hence the seed weight per plant (Y) was defined in terms of number of bearing nodes per plant (x_1) and number of pods per bearing node (x_2) and a multiple regression equation in the form $Y = a+b_1x_1+b_2x_2$ was fitted for estimating the relative contribution of these characters on yield. The results further revealed that the above two characters were responsible for 86.73 per cent of variations in seed yield. The correlation matrix for these two characters are given in Table 12(b).

Selection index

Using the multiple regression equation the following selection indices were worked out for each variety and are presented below.

Sl. No.	Variety	Selection indices	Rank
1.	Bragg	19.980	1
2.	JN 2750	19.562	2
3.	PU 26691	19.501	3
4.	Improved Pelican	18.866	4

5.	EC 39824	18.079	5
6.	Monetta	18.027	6
7.	EC 39821	17.377	7
8.	EC 92814	17.202	8
9.	EC 63298	16.521	9
10.	Davis	16.345	10
11.	EC 14437	16.102	11
12.	Ankur	15.765	12
13.	PLS0-18	15.302	13

It can be seen from the above data that the varieties Bragg, JN 2750 and EC 26691 ranked first, second and third according to selection index. These varieties were the top rankers based on mean yield ha^{-1} also. Hence it was concluded that the varieties Bragg, JN 2750 and EC 26691 were the most promising varieties among the 13 varieties tried in the experiment for the first season.

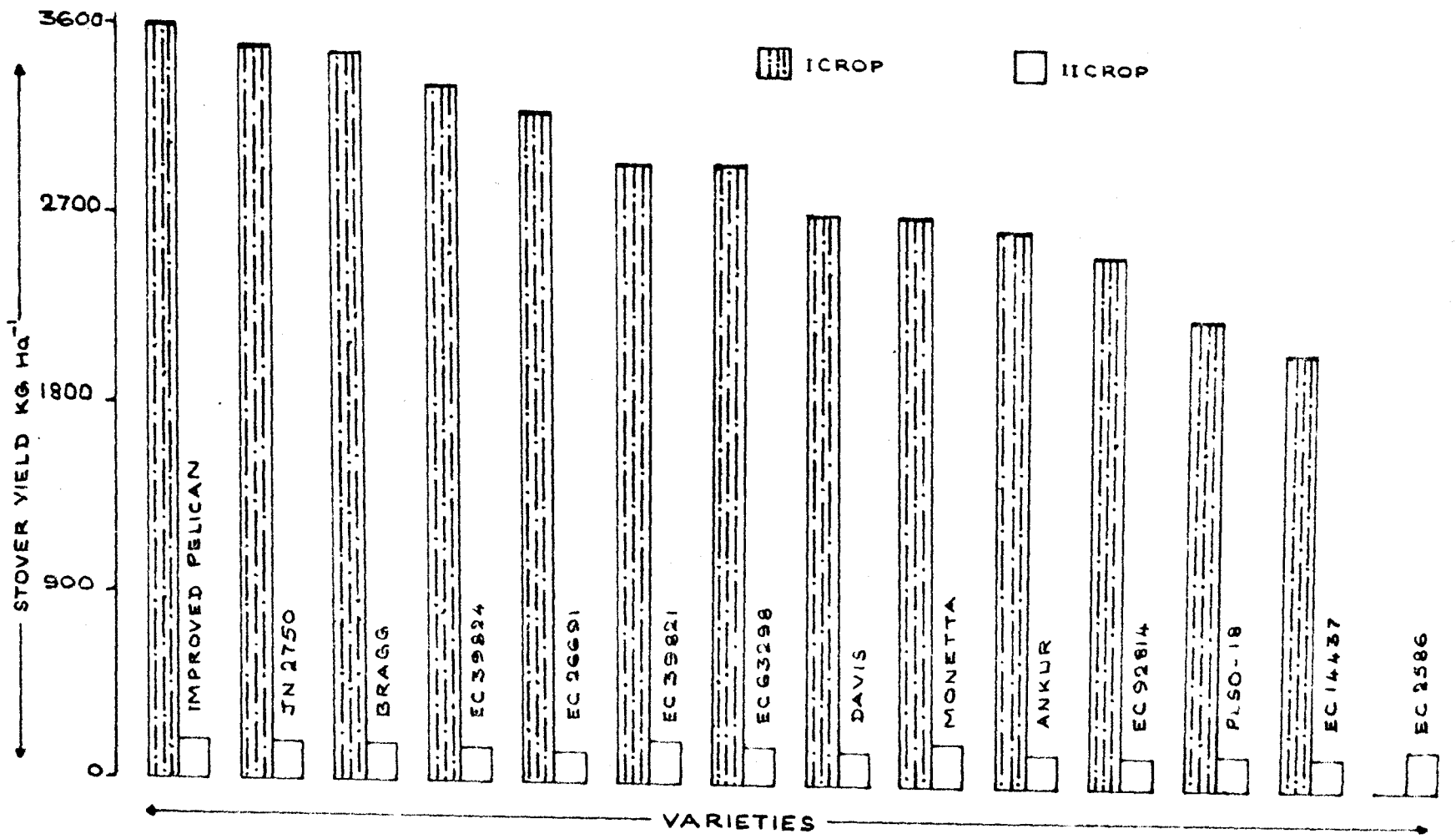
During the second season, the variety PLS0-18 recorded the highest yield of 129 kg ha^{-1} and was on par with EC 2586, Improved Pelicen, EC 63298, JN 2750, Monetta, EC 14437, EC 39821 and Ankur. This variety was superior to EC 26691, Davis, Bragg, EC 92814 and EC 39824.

Seed yield of all the varieties was markedly less in the second season than the first.

(j) Yield of stover

The data on yield of stover are presented in Table 12

FIG. 10. VARIETAL VARIATION ON STOVER YIELD



and Fig.10 and the analysis of variance in Appendix 7.

Significant difference in stover yield was noticed between varieties in both the seasons. In the first season, variety Improved Pelican recorded the highest stover yield of 3616.45 kg ha^{-1} which was on par with JN 2750, Bragg, EC 39824 and EC 26691 but superior to EC 39821, EC 63298, Davis, Monetta, Ankur, EC 92814, PLSO-18, and EC 14457.

During the second season, variety Monetta gave the highest stover yield of 206.8 kg ha^{-1} which was superior to EC 26691, EC 92814, EC 39824 and Davis but on par with all other varieties.

As in the case of seed yield and other growth and yield characters, the stover yield also was lesser in the second season in all the varieties tested.

(k) Harvest index

Data on harvest index are given in Table 12 and the analysis of variance in Appendix 7.

There was no significant varietal difference in the harvest index during both the seasons.

Comparison between seasons showed a lower harvest index in the second season compared to the first.

III Content and uptake of fertiliser nutrients

A. 1. Nitrogen content

(a) Nitrogen content of stem

The data on nitrogen content of stem at various

growth stages are presented in Table 13 and the analysis of variance in Appendix 8.

There was significant varietal difference in the nitrogen content of stem, at all the stages of plant growth except 40th day after sowing in both the seasons.

Comparison between stages indicated an increase in nitrogen content of stem from 40th to 60th day and decline thereafter in the first season. But a gradual decrease in nitrogen content was noticed between stages in the second season.

Higher nitrogen content of the stem was noticed in the second season as compared to the first.

(b) Nitrogen content of leaves

The data on nitrogen content of leaves at different growth stages are presented in Table 14 and the analysis of variance in Appendix 9.

Varietal variation in the nitrogen content of leaves was significant at all the stages in both the seasons.

Comparison between stages showed an increase in nitrogen content of leaves from 40th day to 60th day and a decline thereafter.

There was no consistent variation in the nitrogen content of leaves between seasons.

(c) Nitrogen content of pods

Data on nitrogen content of pods are presented in

Table 13. Nitrogen content of stem at different growth stages of soybean varieties in the two seasons

Treatments	Nitrogen content (%)						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	0.918	1.003	0.816	0.463	1.727	1.627	1.553
2. EC 14437	1.003	1.196	0.720	0.613	1.927	1.567	1.920
3. EC 26691	0.926	1.156	0.876	0.426	1.670	1.603	0.820
4. Improved Pelican	1.060	1.120	0.760	0.456	1.560	1.580	0.720
5. EC 92814	0.982	1.163	0.686	0.463	1.673	1.607	1.187
6. Ankur	0.880	0.830	0.736	0.453	1.700	1.213	1.427
7. PLS0-18	1.010	0.860	0.586	0.436	1.500	1.533	0.987
8. Monetta	0.942	0.700	0.773	0.390	1.747	1.627	0.893
9. Bragg	0.951	1.106	0.793	0.266	1.597	1.587	1.073
10. EC 39824	0.971	1.000	0.973	0.273	1.587	1.687	1.247
11. Davis	1.026	1.043	0.653	0.456	1.323	1.513	0.960
12. JN 2750	0.953	1.043	0.980	0.413	1.820	1.807	1.687
13. EC 62298	1.006	0.926	0.746	0.406	1.603	1.760	1.200
14. EC 2506					1.613	1.050	1.180
F test	NS	S	S	S	NS	S	S
SEm±	0.101	0.0412	2.0801	0.0265	0.1381	0.0961	0.119
C.D. at 5%	-	0.119	0.093	0.079	-	0.280	0.345

Table 14. Nitrogen content of leaves at different growth stages of soybean varieties in the two seasons

Treatments	Nitrogen content (%)				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	2.920	3.610	2.970	2.793	3.227
2. EC 14437	3.206	3.726	1.946	2.980	3.407
3. EC 26693	3.016	3.713	3.056	3.173	3.477
4. Improved Pelican	3.396	3.426	2.736	3.080	3.293
5. EC 92714	3.050	3.683	2.880	3.147	3.347
6. Ankur	2.793	3.186	3.103	3.497	3.230
7. PLS0-18	2.980	3.240	2.313	3.240	3.427
8. Monetta	3.056	3.300	2.673	3.540	3.647
9. Bragg	3.060	3.680	3.200	3.190	3.347
10. EC 39824	3.113	3.180	3.320	3.287	3.373
11. Davis	3.126	3.020	2.233	3.220	3.260
12. JN 2750	2.906	4.053	3.070	2.640	3.190
13. EC 63290	3.823	3.873	3.312	2.680	3.160
14. EC 2586				3.010	2.940
F test	S	S	S	S	S
SEm±	1.740	1.414	1.336	0.171	0.096
C.D. at 5%	0.252	0.370	0.546	0.489	0.278

Table 15 and the analysis of variance in Appendix 10.

The data revealed that there was significant varietal difference in the nitrogen content of green pods in the first season only.

There was no consistent variation in the nitrogen content of green pods between seasons.

(d) Nitrogen content of shells

The data on nitrogen content of shells are given in Table 15 and the analysis of variance in Appendix 10.

There was significant varietal difference in the nitrogen content of shells in both the seasons.

In general the nitrogen content of shells was less in the second season as compared to the first.

(e) Nitrogen content of seeds

Data on the nitrogen content of seeds are presented in Table 15 and the analysis of variance in Appendix 10.

The varieties showed significant difference in the nitrogen content of seeds only in the first season.

No consistent variation in the nitrogen content of seeds was noticed between seasons.

A. 2. Nitrogen uptake

(a) Nitrogen uptake by stem

Data on nitrogen uptake by stem at different stages of plant growth are presented in Table 16 and the analysis of variance in Appendix 11.

Table 15. Nitrogen content of pods, shells and seeds of soybean varieties in the two seasons

Treatments	Nitrogen content (%)					
	Pods		Shells		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	0.806 (1.344)	1.811(1.676)	0.855	0.667	5.061	5.062
2. EC 14437	1.899 (1.702)	3.088 (2.022)	0.860	0.703	4.896	5.220
3. EC 26691	2.434 (1.853)	2.421 (1.849)	0.560	0.583	4.755	4.850
4. Improved Pelican	2.323 (1.823)	2.504 (1.872)	0.774	0.553	5.031	5.140
5. EC 92814	2.309 (1.819)	2.349 (1.830)	0.693	0.617	5.047	5.067
6. Ankur	2.760 (1.959)	1.350 (1.533)	0.707	0.630	4.865	5.067
7. PLSO-18	2.557 (1.886)	2.576 (1.891)	0.728	0.670	5.160	5.030
8. Monatta	2.652 (1.911)	2.399 (1.844)	0.726	0.690	5.760	4.916
9. Bragg	2.561 (1.887	2.033 (1.742)	0.651	0.617	5.711	4.930
10. EC 39824	2.434 (1.853)	2.498 (1.870)	0.700	0.777	5.160	4.455
11. Davis	2.713 (1.927)	2.752 (1.938)	0.616	0.713	5.116	5.050
12. JN 2750	2.606 (1.899)	1.653 (1.629)	0.659	0.680	5.551	5.100
13. EC 63298	2.471 (1.863)	2.449 (1.857)	0.675	0.593	4.960	4.860
14. EC 2586		2.228 (1.797)		0.607		5.027
F test	S	NS	S	S	S	NS
SEm ±	0.057	0.145	0.010	0.032	0.127	0.134
C.D. at 5%	0.168	-	0.035	0.074	0.369	-

Figures in parenthesis indicate $\sqrt{(x+1)}$ transformed value

Table 16. Nitrogen uptake by stem at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of nitrogen (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest after sowing
1. EC 39821	3.197	7.542	35.798	8.026	1.366	2.570	2.921
2. EC 14437	3.441	13.998	12.087	9.202	1.382	2.707	1.885
3. EC 26691	2.319	13.807	32.126	9.367	1.410	2.783	1.236
4. Improved Pelican	4.826	17.845	34.846	12.159	1.349	3.763	1.662
5. EC 92814	4.030	16.861	23.529	9.007	1.296	4.459	1.709
6. Ankur	4.163	6.796	26.758	7.695	1.189	2.193	2.576
7. PLSO-18	4.498	7.252	15.554	7.637	1.540	2.913	1.609
8. Monetta	3.317	8.298	23.373	8.328	2.131	3.467	1.664
9. Bragg	3.703	13.307	41.376	8.271	1.428	2.614	2.284
10. EC 39824	4.532	10.997	48.285	6.186	1.390	6.140	2.567
11. Davis	3.040	14.497	26.767	15.838	1.369	3.915	1.154
12. JN 2750	2.655	14.991	48.907	13.118	1.213	3.856	3.073
13. EC 63298	4.362	10.772	23.419	8.082	1.299	4.322	2.029
14. EC 2586					1.508	2.206	2.225
F test	NS	NS	S	NS	NS	NS	S
SEm±	1.002	4.162	5.770	2.173	0.313	0.832	0.176
C.D. at 5%	-	-	16.841	-	-	-	0.819

There was significant varietal difference oin nitrogen uptake by stem only on 90th day after sowing in the first season and at harvest in the second season.

Comparison between stages indicated a higher nitrogen uptake by stem upto the pod forming stage and a decline thereafter in both the seasons.

(b) Nitrogen uptake by leaves

Data on nitrogen uptake by leaves at different growth stages are presented in Table 17 and the analysis of variance in Appendix 12.

Significant varietal difference in the nitrogen uptake by leaves was noticed only on 90th day after sowing during the first season.

A steady increase in nitrogen uptake by leaves was noticed upto the pod forming stage in both the seasons.

Nitrogen uptake by leaves was conspicuously less in the second season compared to first in all the varieties.

(c) Nitrogen uptake by pods

Data on the uptake of nitrogen by pods are presented in Table 18 and the analysis of variance in Appendix 13.

There was significant difference in the nitrogen uptake by pods in the first season only.

Nitrogen uptake by pods during the second season was considerably less than that of the first season.

(d) Nitrogen uptake by shells

Data on the nitrogen uptake by shells are presented

Table 17. Nitrogen uptake by leaves at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of nitrogen (kg ha^{-1})				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	12.020	29.909	79.794	2.216	5.074
2. EC 14437	11.758	35.263	21.266	2.847	6.009
3. EC 26691	7.837	41.397	88.598	3.281	6.646
4. Improved Pelican	16.245	41.190	81.746	2.869	6.927
5. EC 92814	14.055	43.666	65.088	2.756	9.502
6. Ankur	13.186	25.089	72.139	2.329	6.020
7. PK80-18	10.791	25.369	44.372	3.675	7.490
8. Monetta	11.306	32.989	55.122	4.807	5.060
9. Bragg	11.873	41.972	110.741	3.009	5.587
10. EC 39824	11.725	34.158	111.350	2.987	6.242
11. Davis	9.676	37.619	54.933	3.436	5.888
12. JN 2750	8.484	54.827	96.543	2.007	6.796
13. EC 63298	10.347	38.653	64.879	2.731	8.064
14. EC 2586				2.292	4.499
F test	NS	NS	S	NS	NS
SEm±	2.173	10.182	13.416	0.725	1.652
C.D. at 5%	-	-	39.161	-	-

in Table 18 and the analysis of variance in Appendix 13.

Varieties did not show any significant difference in the nitrogen uptake by shells in both the seasons.

Comparison between seasons showed that the nitrogen uptake by shells was markedly less during the second season.

(e) Nitrogen uptake by seeds

Data on nitrogen uptake by seeds are presented in Table 18 and the analysis of variance in Appendix 13.

Significant varietal variation on nitrogen uptake by seeds was noticed only in second season.

The uptake of nitrogen by seeds was less during the second season.

(f) Nitrogen uptake by plants

Data on total uptake of nitrogen by plants are presented in Table 19 and the analysis of variance in Appendix 14. Total uptake of nitrogen at harvest is shown in Fig. 11.

Varietal difference in the total nitrogen uptake by plants was significant only on 90th day of the first season and at harvest stage of the second season.

A steady increase in the total nitrogen uptake was noticed upto harvest in the first season while a decline in uptake was observed after 60th day in the second season.

Comparison between seasons also showed that the total nitrogen uptake by plants in the second season was

Table 18. Nitrogen uptake by pods, shells and seeds of soybean varieties in the two seasons

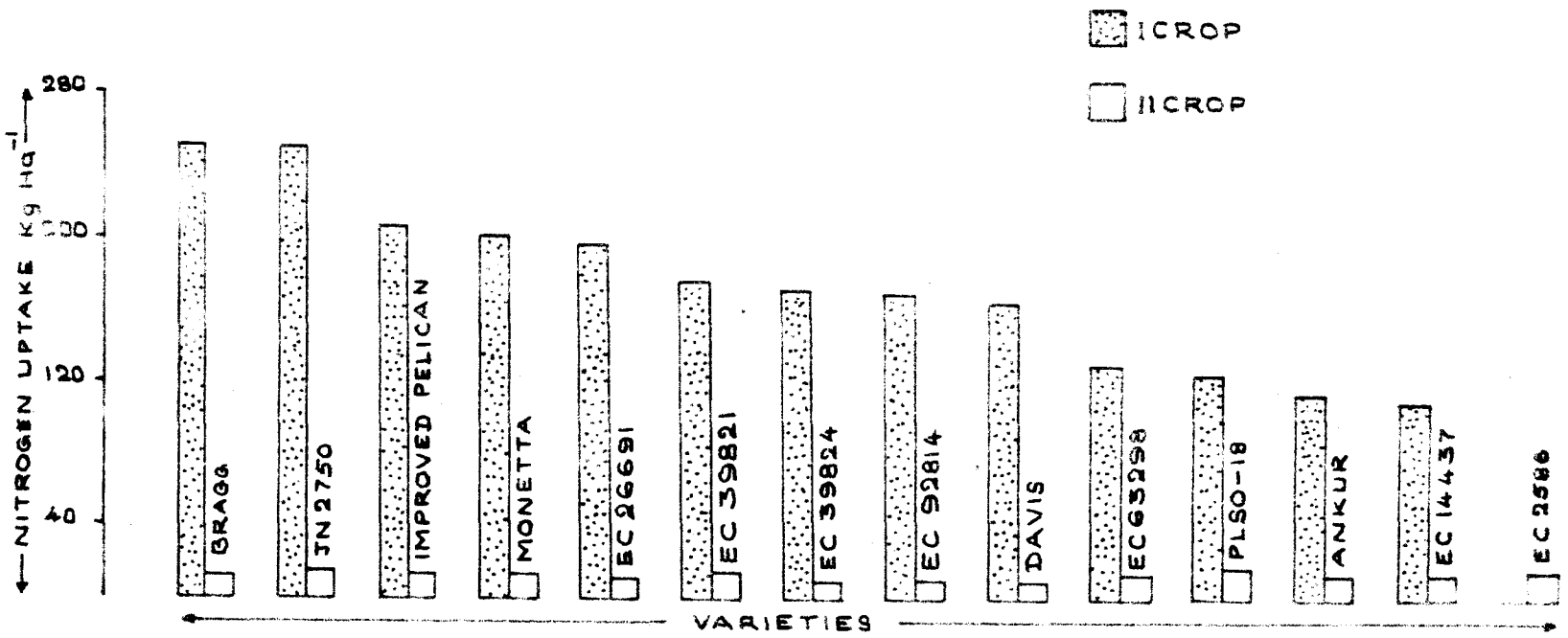
Treatments	Uptake of nitrogen (kg ha^{-1})					
	Pods		Shells		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	12.647(3.694)	0.646(1.283)	14.653	0.981	154.852	11.044
2. EC 14437	14.297 (3.911)	1.088(1.445)	11.551	1.043	90.455	10.923
3. EC 26691	42.364(6.585)	0.693(1.301)	13.050	0.898	168.616	7.642
4. Improved Pelican	46.082(6.862)	1.449(1.565)	18.184	1.090	176.320	12.128
5. EC 92814	43.724(6.688)	1.105(1.451)	12.491	1.183	149.160	6.582
6. Ankur	53.849(7.406)	0.997(1.413)	7.758	0.984	97.886	10.120
7. PLSO-18	41.913(6.551)	1.589(1.609)	10.834	1.379	104.928	13.706
8. Monetta	54.205(7.430)	0.575(1.255)	16.118	0.951	177.788	13.914
9. Bragg	66.355(8.207)	0.748(1.322)	16.196	0.854	227.933	8.567
10. EC 39824	39.696(6.379)	0.688(1.298)	12.879	0.824	153.834	5.720
11. Davis	43.883(6.699)	1.100(1.449)	9.036	0.979	138.460	7.660
12. JN 2750	39.851(6.395)	0.713(1.309)	15.954	1.298	222.994	10.751
13. EC 63298	24.341(5.034)	0.812(1.346)	11.851	0.864	119.565	10.090
14. EC 2586		0.471(1.216)		1.650		11.526
F test	S	NS	NS	NS	NS	NS
SEm±	0.753	0.176	2.837	0.208	0.978	1.420
C.D. at 5%	2.197	-	-	-	-	4.128

Figures in parenthesis indicate $\sqrt{x+1}$ transformed value

Table 19. Total nitrogen uptake by plants at different growth stages of soybean varieties in the two seasons

Treatments	Total uptake of nitrogen (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	15.218	37.472	131.96	177.532	3.582	25.258	15.309
2. EC 14437	15.207	49.262	48.01	111.211	4.228	29.444	13.052
3. EC 26691	10.156	55.262	163.24	195.034	4.691	30.474	9.777
4. Improved Pelican	21.071	58.976	163.50	206.658	4.218	36.438	14.895
5. EC 92814	18.085	60.528	132.16	170.658	3.697	45.444	9.475
6. Ankur	17.343	31.886	156.20	113.340	3.385	27.895	13.681
7. PLS0-18	18.625	33.276	103.24	122.815	5.216	36.036	16.695
8. Monetta	13.826	41.193	134.20	202.205	6.938	29.409	14.605
9. Bragg	14.976	55.343	198.55	252.401	4.517	28.574	11.708
10. EC 39824	16.258	45.155	200.02	172.899	4.376	34.228	9.113
11. Davis	12.718	52.117	127.09	163.334	4.805	33.158	9.794
12. JN 2750	11.139	68.819	186.36	252.066	3.208	37.289	15.216
13. EC 63298	14.710	49.426	115.39	139.497	5.697	39.606	12.984
14. EC 2586					5.600	21.556	15.735
F test	NS	NS	S	NS	NS	NS	S
SEm±	2.829	14.128	25.52	38.969	1.058	2.522	1.496
C.D. at 5%	-	-	52.67	-	-	-	4.350

FIG. 1. VARIETAL VARIATION ON TOTAL NITROGEN UPTAKE BY PLANTS AT HARVEST



considerably less compared to first in all the varieties.

B.1. Phosphorus content

(a) Phosphorus content of stem

The data on the phosphorus content of stem at various growth stages are presented in Table 20 and the analysis of variance in Appendix 15.

There was significant varietal difference in the phosphorus content of stem at all the growth stages except at the harvest stage of the second season.

A steady decrease in the phosphorus content of stem was noticed with age of the crop in the first season. But in the second season, there was an initial increase upto 60th day and a decline thereafter.

The phosphorus content of stem in the second season was less compared to first in all the varieties.

(b) Phosphorus content of leaves

The data on the phosphorus content of leaves at different stages of plant growth are presented in Table 21 and the analysis of variance in Appendix 16.

Significant varietal difference in the phosphorus content of leaves was noticed at all the growth stages in both seasons.

A steady decline in phosphorus content of leaves was noticed with advancement of crop growth in all the varieties.

Table 20. Phosphorus content of stem at different growth stages of soybean varieties in the two seasons

Treatments	Phosphorus content (%)						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	0.566	0.336	0.032	0.017	0.071	0.082	0.022
2. EC 14437	0.468	0.312	0.066	0.028	0.048	0.072	0.058
3. EC 26695	0.457	0.202	0.037	0.020	0.042	0.081	0.044
4. Improved Pelican	0.382	0.246	0.026	0.025	0.022	0.071	0.017
5. EC 92814	0.397	0.242	0.035	0.019	0.061	0.071	0.029
6. Ankur	0.462	0.501	0.035	0.028	0.088	0.130	0.021
7. PLSO-18	0.307	0.202	0.038	0.030	0.074	0.134	0.026
8. Monetta	0.440	0.215	0.013	0.011	0.056	0.056	0.025
9. Bragg	0.298	0.206	0.044	0.016	0.060	0.103	0.027
10. EC 39824	0.302	0.206	0.024	0.011	0.036	0.058	0.027
11. Davis	0.469	0.215	0.033	0.029	0.044	0.077	0.026
12. JH 2750	0.298	0.266	0.035	0.017	0.052	0.075	0.029
13. EC 65298	0.312	0.206	0.035	0.015	0.091	0.085	0.029
14. EC 2586					0.086	0.088	0.023
F test	S	S	S	S	S	S	NS
SEm±	0.224	0.014	0.003	0.003	0.008	0.008	0.0130
C.D. at 5%	0.064	0.042	0.0095	0.007	0.025	0.022	-

Table 21. Phosphorus content of leaves at different growth stages of soybean varieties in the two seasons

Treatments	Phosphorus content (%)				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	0.883	0.588	0.202	0.191	0.112
2. EC 14437	0.706	0.598	0.527	0.213	0.124
3. EC 26691	0.572	0.457	0.202	0.147	0.081
4. Improved Pelican	0.420	0.418	0.204	0.137	0.115
5. EC 92814	0.474	0.372	0.212	0.151	0.108
6. Ankur	0.620	0.549	0.276	0.226	0.165
7. PLSO-18	0.591	0.336	0.186	0.137	0.163
8. Monetta	0.519	0.446	0.190	0.182	0.120
9. Bragg	0.467	0.344	0.392	0.153	0.077
10. EC 39824	0.392	0.378	0.172	0.146	0.093
11. Davis	0.416	0.367	0.163	0.144	0.093
12. JN 2750	0.416	0.317	0.197	0.111	0.113
13. EC 63298	0.480	0.340	0.202	0.155	0.101
14. EC 2586				0.129	0.123
F test	S	S	S	S	S
SEm±	0.018	0.014	0.054	0.006	0.006
C.D. at 5%	0.054	0.041	0.158	0.018	0.020

Comparison between seasons also showed lower contents in the second season compared to first in all the cultivars.

(c) Phosphorus content of pods

Data on phosphorus content of pods are presented in Table 22 and the analysis of variance in Appendix 17.

There was significant varietal variation in phosphorus content of pods in the first season only.

Phosphorus content of pods was also less in the second season compared to first.

(d) Phosphorus content of shells

The data on phosphorus content of shells are given in Table 22 and the analysis of variance in Appendix 17.

There was significant varietal difference in phosphorus content of shells in both seasons.

Phosphorus content of shells was considerably higher in the second season compared to first in all cultivars.

(e) Phosphorus content of seeds

Data on phosphorus content of seeds are presented in Table 22 and the analysis of variance in Appendix 17.

The varieties showed significant differences in the phosphorus content of seeds only in the first season.

Phosphorus content of seeds was conspicuously less in the second season compared to first in all the varieties.

Table 22. Phosphorus content of pods, shells and seeds of soybean varieties in the two seasons

Treatments	Phosphorus content ( )					
	Pods		Shell		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	0.216(1.103)	0.108(1.082)	0.031	0.114	0.589	0.262
2. EC 14437	0.416 (1.190)	0.211(1.1005)	0.118	0.162	0.534	0.279
3. EC 26691	0.329(1.158)	0.181(1.087)	0.042	0.079	0.374	0.247
4. Improved Pelican	0.322 (1.150)	0.143(1.069)	0.034	0.108	0.374	0.293
5. EC 92814	0.350(1.162)	0.175(1.084)	0.029	0.111	0.476	0.271
6. Ankur	0.442(1.201)	0.149(1.073)	0.057	0.119	0.506	0.303
7. PL30-18	0.315(1.147)	0.173(1.084)	0.070	0.087	0.531	0.286
8. Monetta	0.304(1.142)	0.151(1.074)	0.040	0.093	0.460	0.238
9. Bragg	0.308(1.144)	0.193(1.092)	0.044	0.132	0.457	0.242
10. EC 39824	0.320(1.149)	0.164(1.079)	0.036	0.088	0.519	0.233
11. Davis	0.338(1.157)	0.151(1.073)	0.041	0.087	0.454	0.243
12. JU 2750	0.354(1.164)	0.133(1.064)	0.032	0.083	0.298	0.238
13. EC 63298	0.336(1.156)	0.174(1.084)	0.063	0.079	0.481	0.300
14. EC 2586		0.228(1.108)		0.071		0.267
F test	S	NS	S	S	S	NS
SEm±	0.015	0.014	0.006	0.014	0.024	0.018
C.D. at 5%	0.044	-	0.015	0.041	0.070	-

Figures in parenthesis indicate $\sqrt{x+1}$ transformed value

B.2. Phosphorus uptake

(a) Phosphorus uptake by stem

Data on phosphorus uptake by stem at different stages of plant growth are presented in Table 23 and the analysis of variance in Appendix 18.

There was significant varietal difference in phosphorus uptake by stem only on 90th day in the first season and on 40th day in the second season.

Comparison between stages indicated an increase in the phosphorus uptake upto 60th day and a decline thereafter in all the varieties in both the seasons.

Phosphorus uptake by stem was drastically less in the second season compared to first in all the cultivars.

(b) Phosphorus uptake by leaves

Data on phosphorus uptake by leaves are presented in Table 24 and the analysis of variance in Appendix 19.

Varietal difference in phosphorus uptake by leaves was significant on 40th day of the first season only.

A steady increase in phosphorus uptake by leaves was noticed with age of the crop in both the seasons.

Phosphorus uptake by leaves was considerably less in the second season compared to first in all the varieties tested.

(c) Phosphorus uptake by pods

Data on the phosphorus uptake by pods are presented

Table 23. Phosphorus uptake by stem at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of phosphorus by stem (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	2.111	2.605	1.325	0.307	0.056	0.121	0.040
2. EC 14437	1.618	3.655	1.157	0.416	0.084	0.129	0.050
3. EC 26691	1.098	2.527	1.357	0.493	0.034	0.160	0.035
4. Improved Pelican	1.771	3.908	1.691	0.691	0.020	0.172	0.039
5. EC 92814	1.598	3.422	0.750	0.349	0.048	0.183	0.044
6. Ankur	2.180	4.117	1.311	0.497	0.054	0.238	0.033
7. PLS0-18	1.396	1.630	0.827	0.530	0.073	0.260	0.042
8. Monetta	1.605	2.417	0.421	0.236	0.070	0.309	0.052
9. Bragg	0.971	2.447	2.259	0.518	0.051	0.164	0.057
10. EC 39824	1.230	2.283	1.225	0.264	0.030	0.118	0.054
11. Davis	1.404	2.930	1.362	0.761	0.047	0.144	0.037
12. JN 2750	0.773	4.231	1.774	0.518	0.042	0.167	0.042
13. EC 63298	1.360	2.311	1.124	0.261	0.074	0.208	0.039
14. EC 2586					0.058	0.144	0.080
F test	NS	NS	S	NS	S	NS	NS
SEm±	0.358	0.946	0.234	0.116	0.012	0.044	0.008
C.D. at 5%	-	-	0.683	-	0.003	-	-

Table 24. Phosphorus uptake by leaves at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of phosphorus (kg ha^{-1}) First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39021	3.650	4.865	5.195	0.151	0.176
2. EC 14437	2.615	6.240	5.786	0.192	0.220
3. EC 26691	1.489	5.171	5.870	0.154	0.148
4. Improved Pelican	2.087	4.920	6.086	0.127	0.242
5. EC 92814	2.094	4.480	4.637	0.132	0.307
6. Ankur	2.948	4.343	6.411	0.150	0.303
7. PLS0-18	2.763	2.637	3.964	0.154	0.357
8. Monetta	1.935	4.465	4.172	0.249	0.156
9. Bragg	1.679	3.956	5.850	0.148	0.130
10. EC 39024	1.474	3.758	5.196	0.128	0.180
11. Davis	1.318	4.625	4.350	0.157	0.163
12. JW 2750	1.219	4.382	5.863	0.087	0.249
13. EC 63298	1.802	3.471	3.933	0.140	0.233
14. EC 2586				0.103	0.206
F test	S	NS	NS	NS	NS
SEm±	0.401	1.317	0.978	0.032	0.071
C.D. at 5%	1.171	-	-	-	-

in Table 25 and the analysis of variance in Appendix 20.

There was no significant varietal difference in phosphorus uptake by pods in both the seasons.

Phosphorus uptake by pods was less in the second season compared to first in all the varieties tried.

(d) Phosphorus uptake by shells

Data on the phosphorus uptake by shells are presented in Table 25 and the analysis of variance in Appendix 20.

Varieties did not show any significant variation in phosphorus uptake by shells in both the seasons.

Comparison between seasons showed that the phosphorus uptake by shells was considerably less during the second season in all the cultivars tested.

(e) Phosphorus uptake by seeds

Data on phosphorus uptake by seeds are presented in Table 25 and the analysis of variance in Appendix 20.

There was no significant varietal difference in phosphorus uptake by seeds in both the seasons.

Phosphorus uptake by seeds was markedly less during second season compared to first in all the varieties.

(f) Phosphorus uptake by plants

Data on the total phosphorus uptake by plants at different growth stages are presented in Table 26. The total uptake of phosphorus by plants at harvest is shown in Fig.12. The analysis of variance is given in Appendix 21.

Table 25. hosphorus uptake by pods, shells and seeds of soybean varieties in the two seasons

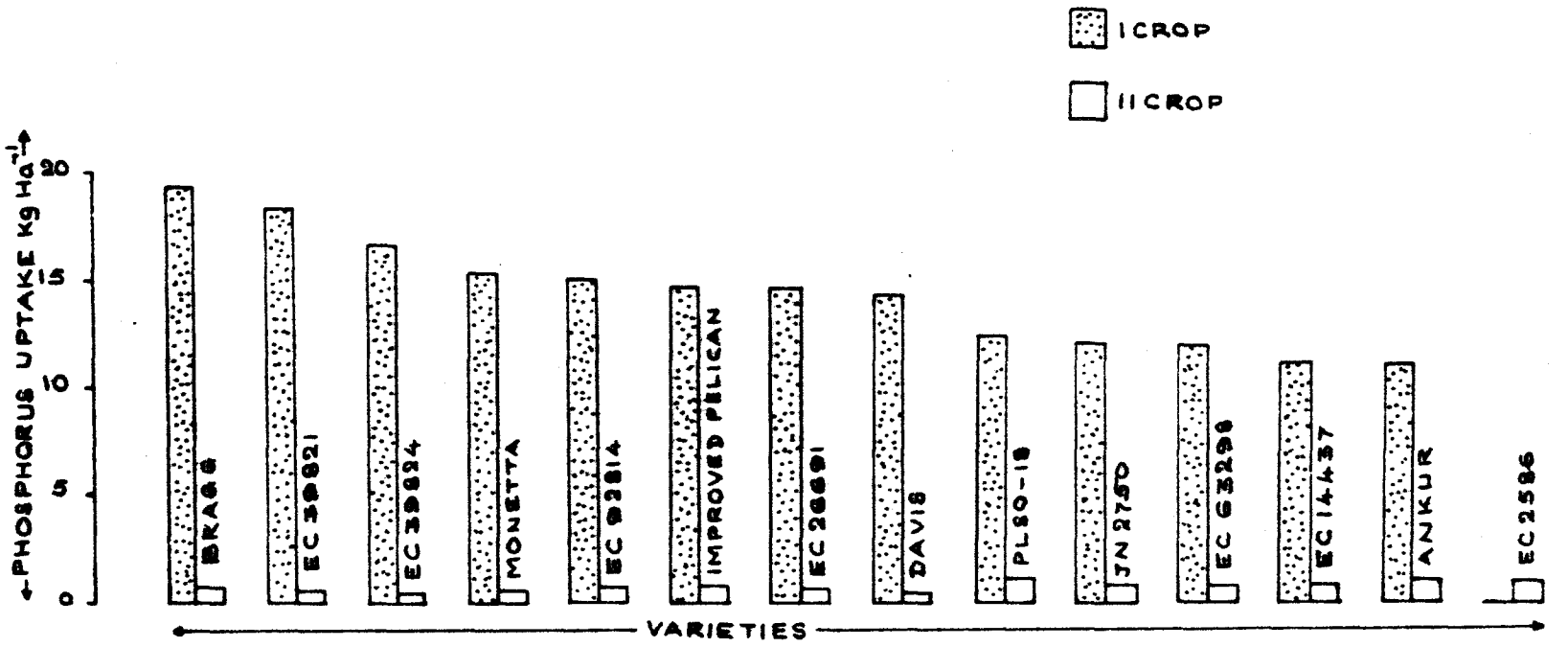
Treatments	Phosphorus uptake (kg ha^{-1})					
	Pods		Shells		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	3.541 (2.131)	0.022 (1.011)	0.560	0.180	17.528	0.314
2. EC 14437	3.169 (2.042)	0.075 (1.037)	1.604	0.239	9.342	0.482
3. EC 26691	5.724 (2.593)	0.047 (1.023)	0.953	0.123	13.234	0.422
4. Improved Pelican	6.409 (2.722)	0.095 (1.047)	0.806	0.220	13.233	0.508
5. EC 92814	6.656 (2.767)	0.097 (1.048)	0.503	0.214	14.336	0.774
6. Ankur	8.610 (3.100)	0.112 (1.054)	0.661	0.180	10.044	0.646
7. PLS0-18	5.175 (2.485)	0.122 (1.054)	1.079	0.158	10.842	0.744
8.Monetta	6.279 (2.698)	0.044 (1.022)	0.739	0.140	14.264	0.456
9. Bragg	7.323 (2.885)	0.072 (1.036)	1.098	0.179	17.825	0.413
10. EC 39024	7.680 (2.946)	0.047 (1.023)	0.675	0.302	15.782	0.341
11. Davis	6.006 (2.647)	0.068 (1.033)	0.582	0.120	12.987	0.308
12. JN 2750	5.472 (2.544)	0.055 (1.027)	0.731	0.154	10.893	0.679
13. EC 63298	4.269 (2.295)	0.077 (1.038)	0.955	0.114	10.845	0.626
14. EC 2586		0.050 (1.025)		0.193		1.013
F test	NS	NS	NS	NS	NS	NS
SEm ±	1.918	0.0164	0.207	0.060	2.967	0.129
C.D. at 5%	-	-	-	-	-	-

Figures in parenthesis indicate $\sqrt{x+1}$ transformed value

Table 26. Total phosphorus uptake by plants at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of phosphorus by plants (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	5.764	7.470	10.595	18.396	0.206	0.320	0.534
2. EC 14437	4.233	9.895	10.187	11.363	0.226	0.425	0.772
3. EC 26691	2.587	7.696	12.970	14.681	0.188	0.356	0.581
4. Improved Pelican	3.856	8.829	14.267	14.730	0.142	0.509	0.768
5. EC 92814	3.693	7.902	12.060	15.189	0.179	0.589	0.855
6. Ankur	5.129	8.459	16.568	11.200	0.204	0.651	0.858
7. PL80-18	4.160	4.268	10.088	12.452	0.227	0.741	0.944
8. Monetta	3.541	6.882	11.052	15.238	0.319	0.282	0.648
9. Bragg	2.651	6.403	15.561	19.442	0.200	0.366	0.649
10. EC 39824	2.709	6.041	14.236	16.724	0.151	0.346	0.491
11. Davis	2.390	7.555	11.908	14.331	0.204	0.376	0.465
12. JN 2750	1.993	8.614	13.173	12.142	0.157	0.471	0.875
13. EC 63298	3.162	5.782	9.328	12.062	0.214	0.499	0.778
14. EC 2586					0.162	0.380	0.785
F test	NS	NS	NS	NS	NS	NS	NS
SEm±	0.763	2.199	2.216	3.197	0.412	0.137	0.127
C.D. at 5%	-	-	-	-	-	-	-

FIG.12 VARIETAL VARIATION ON TOTAL PHOSPHORUS UPTAKE BY PLANTS AT HARVEST



Varietal difference in the total uptake of phosphorus by plants was not marked at any of the growth stages of both the seasons.

A steady increase in the total phosphorus uptake with age of the crop was noticed in both seasons in almost all the varieties tested.

Comparison between seasons showed that total uptake of phosphorus by plants was less in the second season.

C. 1. Potassium content

(a) Potassium content of stem

The mean values on potassium content of stem at different growth stages are presented in Table 27 and the analysis of variance in Appendix 22.

Varieties showed significant difference in the potassium content of stem at all stages of plant growth in both the seasons.

A steady decline in potassium content of stem with advancement of growth was noticed in both the seasons.

Comparison between seasons showed that the potassium content of stem in the second season was less in all the varieties tested, except at harvest.

(b) Potassium content of leaves

Data on potassium content of leaves are presented in Table 28 and the analysis of variance in Appendix 23.

There was significant varietal difference in

Table 27. Potassium content of stem at different growth stages of soybean varieties in the two seasons

Treatments	Potassium content (%)						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	2.733	2.283	1.700	6.508	1.917	1.317	0.967
2. EC 14437	2.633	2.083	1.450	0.675	2.100	1.450	1.033
3. EC 26691	2.000	2.166	1.300	0.466	1.650	1.383	0.850
4. Improved Pelican	2.533	2.433	1.500	0.766	1.750	0.983	0.800
5. EC 92814	2.233	2.633	1.416	0.266	1.750	1.433	0.900
6. Ankur	1.416	2.250	1.433	0.491	2.017	1.000	0.867
7. PL90-18	2.216	2.016	1.350	0.883	1.333	1.417	0.900
8. Monetta	2.466	2.083	1.083	0.250	1.433	1.317	1.000
9. Bragg	2.090	2.583	1.383	0.600	1.883	1.000	0.883
10. EC 39824	2.283	2.400	1.500	0.333	1.800	1.183	0.900
11. Davis	2.400	2.250	1.216	0.750	1.600	1.150	0.867
12. JN 2750	2.216	2.050	1.350	0.316	1.880	1.233	0.883
13. EC 63298	2.316	2.450	1.466	0.416	1.600	1.250	0.767
14. EC 2586					2.060	1.517	0.750
F test	S	S	S	S	S	S	S
SEm±	0.122	0.060	0.146	0.020	0.006	0.071	0.028
C.D. at 5%	0.358	0.147	0.146	0.059	0.192	0.207	0.080

Table 28. Potassium content of leaves at different growth stages of soybean varieties in the two seasons

Treatments	Potassium content (%)				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	2.083	1.233	1.283	1.700	1.533
2. EC 14437	2.066	1.516	1.400	2.050	1.750
3. EC 26691	1.866	1.300	1.133	1.617	1.650
4. Improved Pelican	0.933	1.450	1.266	2.050	1.500
5. EC 92814	1.083	1.383	1.300	1.167	1.533
6. Ankur	1.566	1.516	1.650	1.767	1.533
7. PLSO-18	1.783	1.433	1.383	1.933	1.567
8. Monetta	1.933	1.066	1.133	1.350	1.567
9. Bragg	1.700	1.450	1.450	1.767	1.550
10. EC 39824	1.466	1.283	1.516	1.330	1.733
11. Davis	1.933	1.383	1.000	1.600	1.583
12. JN 2750	1.466	1.033	1.266	1.483	1.433
13. EC 63298	2.200	1.333	1.533	1.767	1.500
14. EC 2586				1.700	1.500
F test	S	S	S	S	NS
SEm±	0.115	0.075	0.038	0.1165	0.0632
C.D. at 5%	0.336	0.219	0.104	0.339	-

potassium content of leaves in all the growth stages of both the seasons except 60th day of the second season.

A decrease in potassium content of leaves was noticed with age of the crop in almost all varieties tried in both the seasons.

Comparison between seasons in general showed higher contents in the second season.

(c) Potassium content of pods

Data on potassium content of pods are presented in Table 29 and the analysis of variance in Appendix 24.

Varieties showed significant difference in potassium content of pods in the second season only.

The potassium content of pods was considerably less in the second season compared to first in all the varieties tested.

(d) Potassium content of shells

Data on potassium content of shells are presented in Table 29 and the analysis of variance in Appendix 24.

Marked varietal variation in the potassium content of shells was noticed in both the seasons.

In general, the potassium content was less in the second season compared to first.

(f) Potassium content of seeds

Data on potassium content of seeds are presented in Table 29 and the analysis of variance in Appendix 24.

Table 29. Potassium content of pods, shells and seeds of soybean varieties in the two seasons

Treatments	Potassium content (%)					
	Pods		Shells		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	1.129(1.459)	0.507(1.228)	1.300	1.250	1.700	1.133
2. EC 14437	2.013(1.736)	1.161(1.470)	1.016	1.600	1.650	0.950
3. EC 26691	2.048(1.746)	0.999(1.414)	1.283	1.250	1.716	1.417
4. Improved Pelican	2.013(1.736)	0.568(1.252)	1.400	1.400	1.650	1.450
5. EC 92814	1.819(1.679)	1.362(1.537)	1.000	1.300	1.600	1.383
6. Ankur	1.948(1.717)	1.250(1.500)	1.333	1.467	1.633	1.350
7. PLS0-18	1.752(1.659)	1.250(1.500)	1.550	1.517	1.683	1.433
8. Monetta	1.855(1.684)	1.283(1.511)	1.216	1.317	1.683	1.400
9. Bragg	2.013(1.736)	1.515(1.586)	2.000	1.517	1.750	1.300
10. EC 39824	2.097(1.750)	1.333(1.528)	1.816	1.283	1.416	1.350
11. Davis	1.965(1.722)	1.233(1.494)	1.500	1.450	1.350	1.533
12. JN 2750	1.815(1.678)	0.851(1.361)	1.333	1.500	1.563	1.383
13. EC 63298	1.852(1.689)	1.215(1.488)	2.083	1.600	1.683	1.450
14. EC 2586		1.450(1.565)		1.483		1.462
F test	NS	S	S	S	S	S
SEm±	0.065	0.070	0.074	0.066	0.040	0.062
C.D. at 5%	-	0.203	0.216	0.190	0.111	0.182

Figures in parenthesis indicate $\sqrt{(x+1}$ transformed value

There was significant varietal variation in the potassium content of seeds in both the seasons.

Comparison between seasons showed lower potassium content of seeds in the second season.

C.2. Potassium uptake

(a) Potassium uptake by stem

Data on potassium uptake by stem are presented in Table 30 and the analysis of variance in Appendix 25.

Data revealed significant varietal variation in potassium uptake by stem on 90th day and at harvest of the first season only.

Comparison between stages showed a steady increase in potassium uptake upto the pod forming stage and a decline in the maturity phase in both the seasons.

All the varieties showed lower potassium uptake by stem in the second season compared to first.

(b) Potassium uptake by leaves

Data on the potassium uptake by leaves are presented in Table 31 and the analysis of variance in Appendix 26.

There was no significant difference in potassium uptake by leaves in any of the growth stages studied, except 90th day of the first season.

A steady increase in potassium uptake by leaves was noticed throughout the growth period in both the seasons.

Potassium uptake by leaves was also considerably less

Table 30. Potassium uptake by stem at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of potassium (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	10.177	17.607	70.511	8.969	1.537	1.967	1.815
2. EC 14437	9.068	24.619	24.518	10.114	1.494	2.547	1.917
3. EC 26691	4.829	25.141	47.394	10.266	1.405	2.805	1.565
4. Improved Pelican	11.332	38.659	69.027	18.492	1.482	2.390	2.068
5. EC 92814	9.344	37.474	87.667	4.983	1.354	4.095	1.335
6. Ankur	6.823	18.464	52.024	8.381	1.257	1.782	1.375
7. PLSO-18	10.155	15.008	36.366	15.465	1.283	2.727	1.463
8. Monetta	8.450	24.553	32.873	5.333	1.735	1.751	1.848
9. Bragg	7.146	30.819	72.333	16.028	1.737	1.666	1.928
10. EC 39824	9.747	26.379	68.882	8.038	1.573	2.555	1.908
11. Davis	7.121	30.463	50.024	19.420	1.658	2.205	1.260
12. JN 2750	5.718	33.148	67.296	10.369	1.097	2.673	1.913
13. EC 63298	10.239	27.859	46.202	6.932	1.298	3.073	1.593
14. EC 2586					1.457	2.563	1.656
F test	NS	NS	S	S	NS	NS	NS
SEm±	2.331	8.326	10.294	3.129	0.293	0.538	0.224
C.D. at 5%	-	-	30.046	9.133	-	-	-

Table 31. Potassium uptake by leaves at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of potassium by leaves (kg ha^{-1})				
	First season			Second season	
	40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing
1. EC 39821	8.592	10.303	32.469	1.416	2.405
2. EC 14437	7.714	14.455	15.329	1.858	3.122
3. EC 26691	4.891	13.714	32.976	1.880	3.203
4. Improved Pelican	4.296	16.911	39.211	1.610	3.115
5. EC 92814	4.939	16.118	29.848	1.017	4.371
6. Ankur	7.554	11.863	35.520	1.176	2.860
7. PLSO-18	8.353	11.023	28.376	2.292	3.445
8. Monetta	8.864	10.531	23.578	1.868	2.126
9. Bragg	6.151	16.653	50.285	1.740	2.658
10. EC 39624	5.485	13.538	50.431	1.190	3.350
11. Davis	6.130	16.472	25.057	1.711	2.890
12. JN 2750	4.315	18.136	39.937	1.098	3.000
13. EC 63298	8.334	12.917	30.142	1.583	3.519
14. EC 2586				1.320	2.331
F test	NS	NS	S	NS	NS
SEm±	1.690	3.779	5.819	0.3996	0.7772
C.D. at 5%	-	-	16.986	-	-

in the second season compared to first in all the varieties tested.

(c) Potassium uptake by pod

Data on the potassium uptake by pods are presented in Table 32 and the analysis of variance in Appendix 27.

No marked varietal difference in the potassium uptake by pods was noticed in either of the seasons.

Potassium uptake by pods was markedly less in the second season compared to first in all the varieties.

(d) Potassium uptake by shells

Data on the potassium uptake by shells are presented in Table 32 and the analysis of variance in Appendix 27.

Significant varietal variation in potassium uptake by shells was noticed in both the seasons.

Potassium uptake by shells in the second season was less compared to the first season.

(e) Potassium uptake by seeds

Data on the potassium uptake by seeds are presented in Table 32 and the analysis of variance in Appendix 27.

There was significant varietal difference in potassium uptake by seeds only in the second season.

All the cultivars under test showed conspicuously lower potassium uptake by seeds in the second season compared to first.

Table 32. Potassium uptake by pods, shells and seeds of soybean varieties in the two seasons

Treatments	Uptake of potassium (kg ha^{-1})					
	Pods		Shell		Seeds	
	First season	Second season	First season	Second season	First season	Second season
1. EC 39821	18.120 (4.372)	0.105 (1.051)	23.701	1.800	49.625	1.364
2. EC 14437	15.467 (4.058)	0.424 (1.193)	13.895	2.150	29.953	1.657
3. EC 26691	35.323 (6.027)	0.578 (1.125)	29.775	1.910	59.994	2.461
4. Improved Pelicem	40.648 (6.454)	0.821 (1.349)	31.923	2.801	56.676	2.498
5. EC 92814	34.409(5.951)	0.891 (1.375)	18.072	2.500	47.403	3.758
6. Ankur	37.848 (6.233)	0.573 (1.254)	14.695	2.445	29.627	2.719
7. PLS0-18	28.712 (5.451)	0.883 (1.374)	22.740	3.211	34.439	3.682
8. Monetta	37.425 (6.199)	0.334 (1.155)	25.886	1.932	51.876	2.689
9. Bragg	47.595 (6.971)	0.560 (1.249)	49.733	2.050	68.896	2.220
10. EC 39824	34.294 (5.941)	0.375 (1.172)	31.811	1.370	42.914	1.983
11. Davis	31.565 (5.707)	0.525 (1.235)	21.968	1.981	36.469	1.811
12. JN 2750	27.724 (5.360)	0.360 (1.166)	30.568	2.852	61.589	4.002
13. EC 63298	23.567 (4.957)	0.408 (1.187)	31.449	2.341	40.489	3.028
14. EC 2586		0.512 (1.145)		4.060		4.823
F test	NS	NS	S	S	NS	S
SEm±	0.733	0.103	5.593	0.450	10.697	0.591
C.D. at 5%	-	-	16.325	0.131	-	1.717

Figures in parentheis indicate $\sqrt{x+1}$ transformed value

(f) Potassium uptake by plants

Data on potassium uptake by plants at various growth stages are presented in Table 33 and the analysis of variance in Appendix 28. Total uptake of potassium by plants at harvest is shown in Fig.13.

No marked varietal difference in the potassium uptake by plants was noticed at any of the growth stages of the two seasons studied except at the harvest stage of the second season.

Comparison between stages showed a steady increase in the potassium uptake upto 90th day and a decline thereafter in the first season. But during second season, a steady increase in potassium uptake was noticed upto harvest in many of the varieties tested.

Total potassium uptake by plants was conspicuously less in the second season compared to first in all the varieties tested.

IV. Quality aspects

(a) Protein content of seed

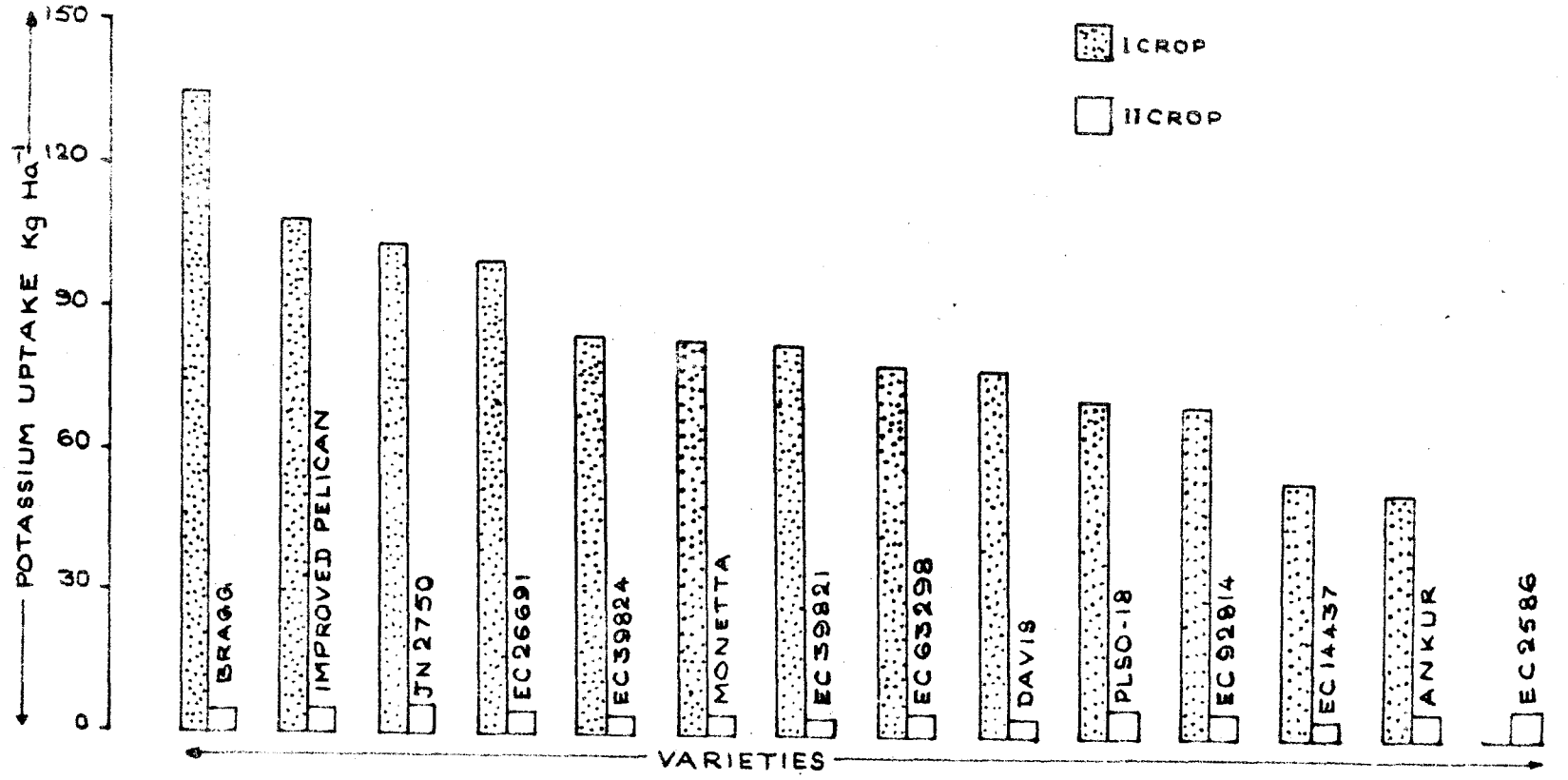
Data on protein content of seeds are presented in Table 34 and Fig.14. The analysis of variance is given in Appendix 29.

Significant varietal difference in protein content of seed was noticed in the first season only and the variety Manetta recorded the highest protein content of

Table 33. Potassium uptake by plants at different growth stages of soybean varieties in the two seasons

Treatments	Uptake of potassium by plants (kg ha^{-1})						
	First season				Second season		
	40th day after sowing	60th day after sowing	90th day after sowing	Harvest a	40th day after sowing	60th day after sowing	Harvest
1. EC 39821	18.768	27.911	126.370	82.296	2.683	4.484	4.978
2. EC 14437	16.783	39.075	55.617	53.961	3.352	6.100	5.722
3. EC 26691	9.720	38.719	115.789	100.042	3.286	6.282	5.934
4. Improved Pelican	15.629	55.571	149.599	107.090	3.092	8.353	7.478
5. EC 92814	14.276	53.593	112.017	70.458	2.371	9.406	7.588
6. Ankur	14.377	50.327	126.538	52.702	2.453	5.248	6.812
7. PLS0-18	15.508	26.032	94.475	71.652	3.978	7.147	9.198
8. Monetta	17.314	35.085	94.848	83.095	3.605	4.239	6.466
9. Bragg	13.298	47.272	171.133	135.364	3.476	4.890	6.200
10. EC 39824	15.233	39.916	154.288	84.096	2.764	6.147	5.263
11. Davis	13.251	46.936	107.938	77.854	3.370	5.663	5.263
12. JN 2750	10.033	51.262	135.631	104.192	2.195	6.049	8.760
13. EC 63298	16.573	40.776	100.031	78.870	2.887	7.005	6.956
14. EC 2586					2.777	5.212	10.535
F test	NS	NS	NS	NS	NS	S NS	S
SEm±	3.756	11.673	22.060	18.098	0.692	1.493	0.968
C.D. at 5%	-	-	-	-	-	-	2.814

FIG. 13. VARIETAL VARIATION ON TOTAL POTASSIUM UPTAKE BY PLANTS AT HARVEST



36 per cent, which was on par with Bragg and JU 2750 and higher than all other varieties.

There was no seasonal difference in the protein content of the variety EC 39821. But the varieties EC 14437, EC 26691, Improved Pelican, EC 92814 and Ankur recorded higher seed protein content in the second season while the remaining ones gave lower values.

Among the varieties tested, the protein content ranged from 29.72 per cent to 36 per cent in first season and from 28.46 per cent to 32.63 per cent in second season.

(b) Protein yield of seed

Data on the protein yield per hectare are presented in Table 34 and Fig.15 and the analysis of variance in Appendix 29.

Significant varietal difference in protein yield was observed in both the seasons. During the first season, the variety Bragg recorded the highest protein yield of 825.65 kg ha^{-1} while in the second season the variety EC 2586 gave the highest protein yield of 41.64 kg ha^{-1}. The ranges of protein yield for the first and second seasons were 431.53 kg ha^{-1} to 825.65 kg ha^{-1} and 18.47 kg ha^{-1} to 41.64 kg ha^{-1} respectively.

Protein yield was considerably less in the second season compared to first.

Table 34. Protein content, protein yield, oil content and oil yield of soybean varieties in the two seasons

Treatments	Protein content (%)		Protein yield (kg ha^{-1})		Oil content (%)		Oil yield (kg ha^{-1})	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
1. EC39821	31.64	31.64	656.12	32.80	15.79	15.33	327.08	16.49
2. EC 14437	30.60	32.63	451.54	34.35	18.45	19.93	259.96	21.74
3. EC 26691	29.72	30.31	667.43	24.59	14.09	18.36	396.60	14.45
4. Improved Pelican	31.44	32.12	673.41	41.30	21.09	17.98	438.90	22.16
5. EC 92814	31.55	31.66	580.67	21.26	21.22	16.07	390.20	10.93
6. Ankur	30.40	31.67	582.50	29.46	21.30	17.41	407.04	17.01
7. PLS0-18	32.25	31.44	451.81	39.55	17.77	17.59	237.03	22.69
8. Monetta	36.00	30.74	763.53	32.48	16.44	16.02	348.44	17.94
9. Bragg	35.69	30.81	825.65	22.26	18.49	15.92	428.87	11.88
10. EC 39824	32.25	28.46	670.66	18.48	20.31	17.09	421.37	10.92
11. Davis	31.98	31.56	614.79	21.63	20.59	16.54	395.57	12.51
12. JN 2750	34.70	31.87	772.26	38.79	18.86	15.93	417.20	18.40
13. EC 63298	30.99	30.37	673.41	37.67	15.10	17.13	370.29	19.86
14. EC 2586		31.41		41.64		17.61		22.70
F test	S	NS	S	S	S	S	S	S
SEm±	0.789	0.831	56.467	3.781	1.057	0.030	38.331	2.014
C.D. at 5%	2.305	-	164.824	9.789	3.087	1.200	111.855	4.257

FIG. 14 VARIETAL VARIATION ON PROTEIN CONTENT OF SOYBEAN SEEDS

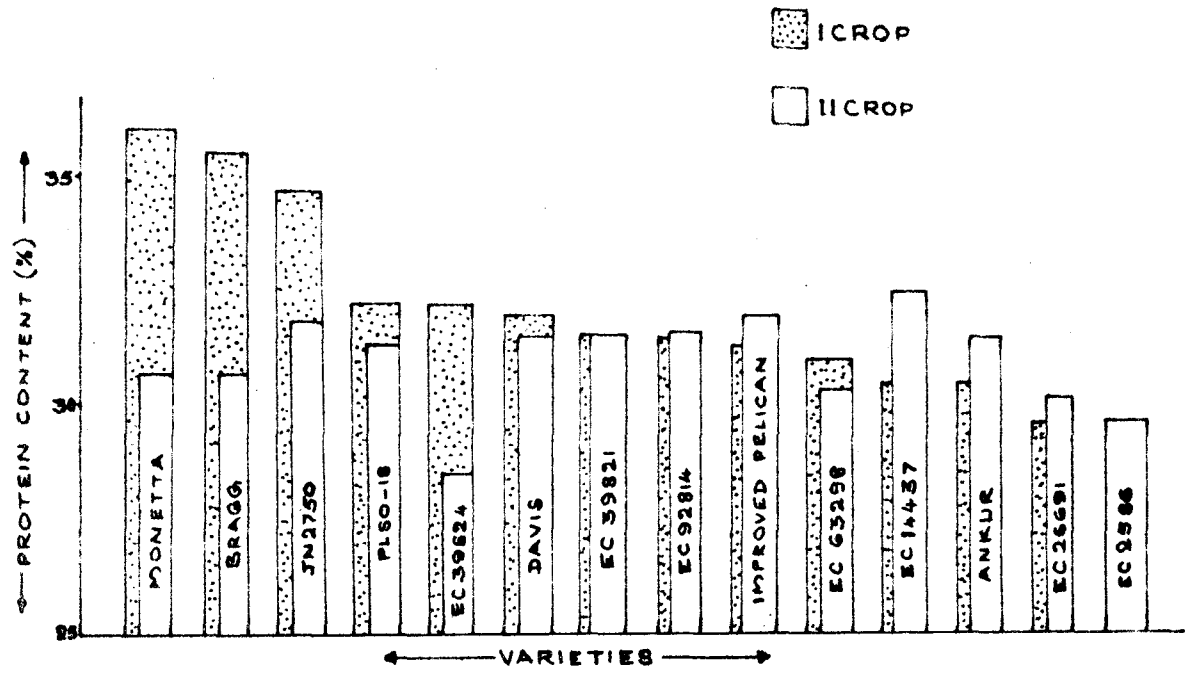
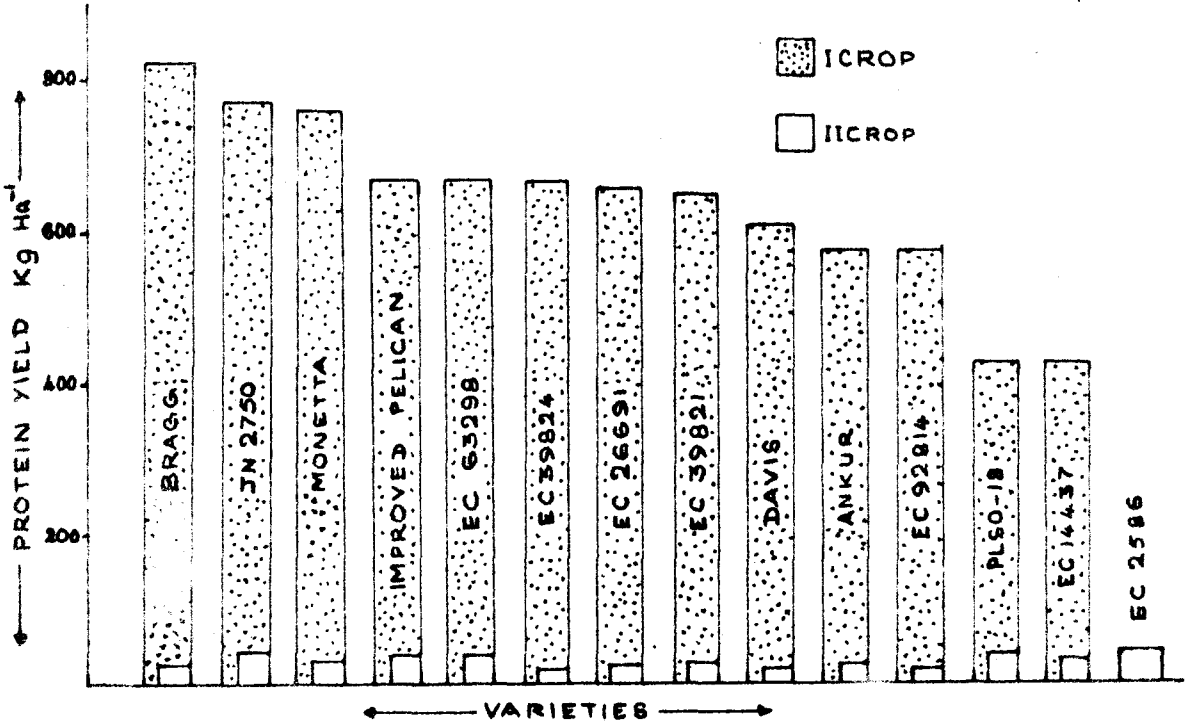


FIG. 15 VARIETAL VARIATION ON PROTEIN YIELD



(c) Oil content of seeds

Data on the oil content of seeds are presented in Table 34 and Fig.16. The analysis of variance is given in Appendix 29.

There was significant varietal variation in the oil content of seed in both the seasons.

In the first season, variety Ankur recorded the highest oil content of 21.30 per cent which was on par with those of varieties EC 92814, Improved Pelican, Davis, EC 39824, JW 2750, Bragg and EC 14437 but higher than all the varieties. But during second season, variety EC 14437 gave the highest oil content of 19.93 Per cent and was higher than the contents of all other varieties.

The range in the oil contents among the varieties were 14.09 to 21.30 per cent and 15.33 to 19.93 per cent in the first and second season respectively.

Comparison between seasons indicated that the oil content in the second season in all the varieties was less except EC 14437 and EC 26691.

(d) Oil yield

Data on oil yield per hectare are presented in Table 34 and Fig.17 and the analysis of variance is given in Appendix 29.

Marked varietal variation in the oil yield was noticed in both the seasons.

FIG. 16. VARIETAL VARIATION ON OIL CONTENT OF SOYBEAN SEEDS

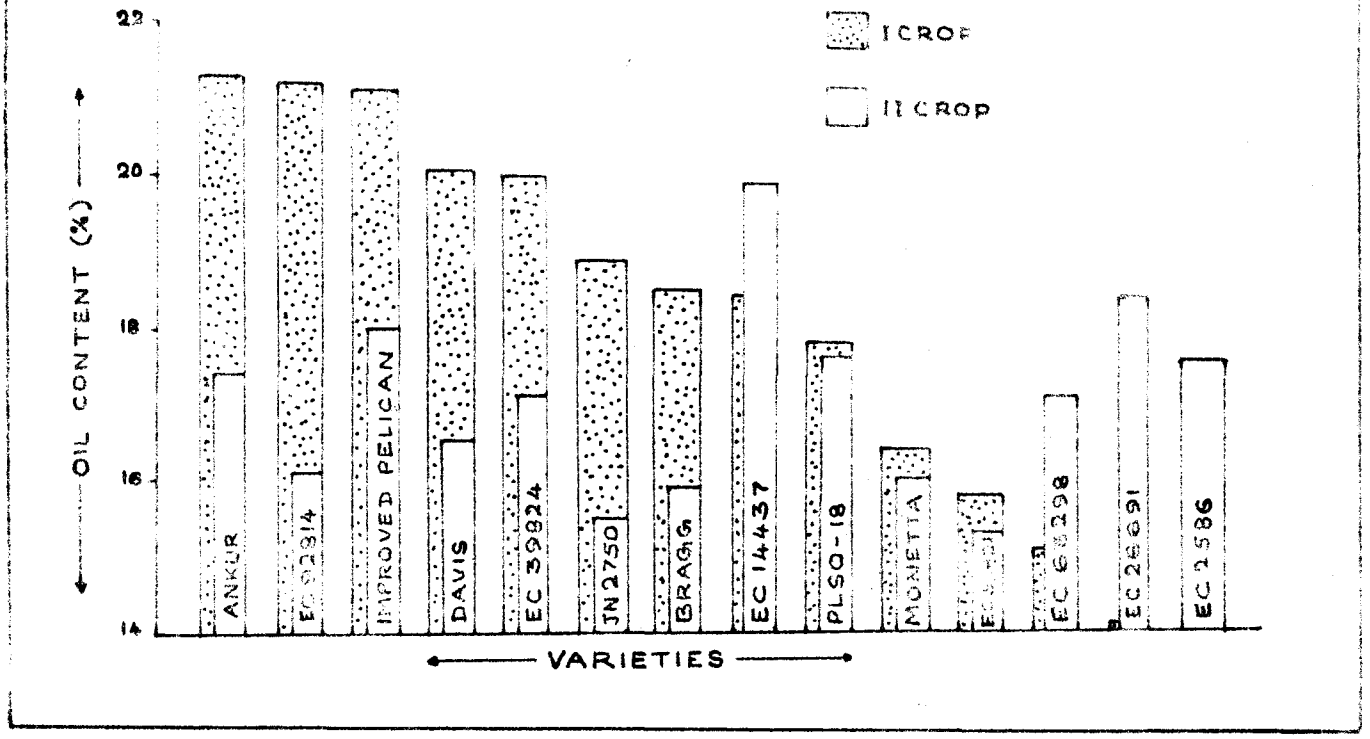
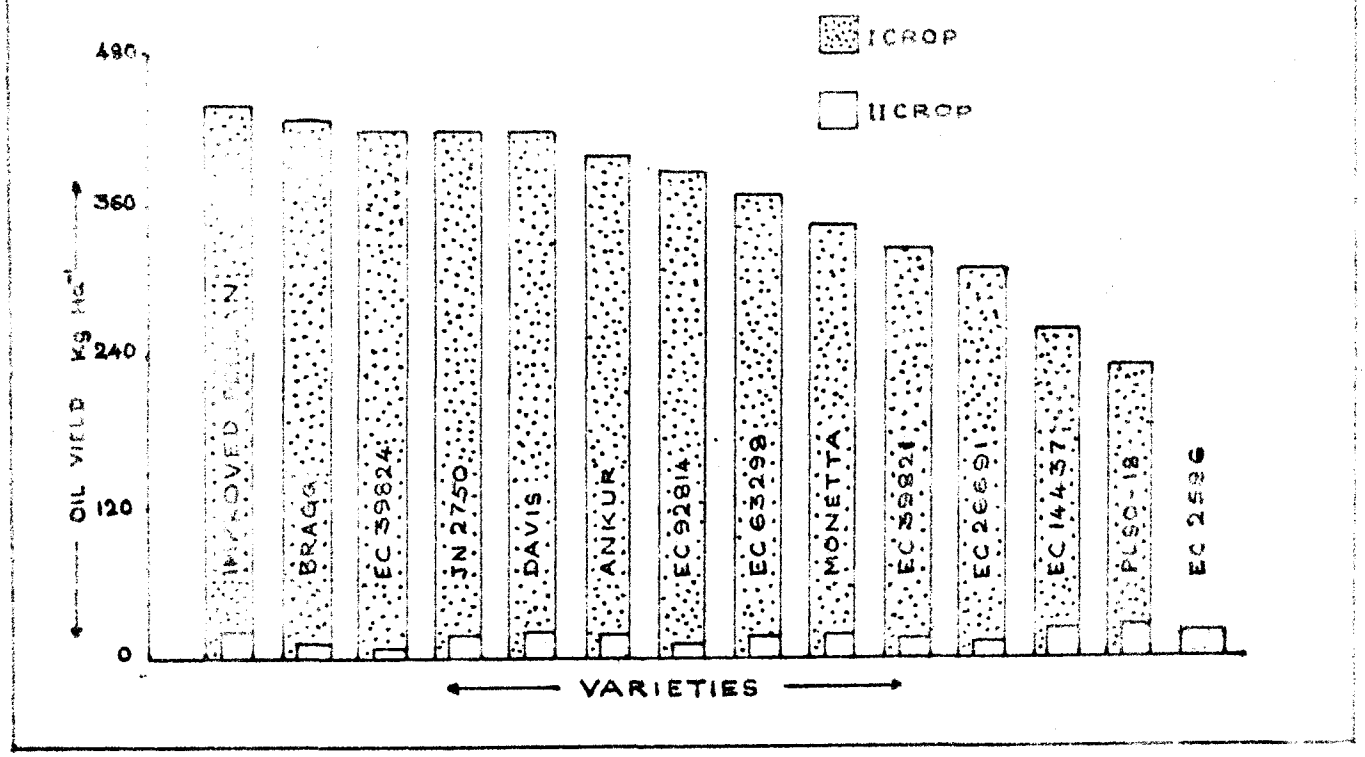


FIG 7. VARIETAL VARIATION ON OIL YIELD



In first season, variety Improved Pelican recorded the highest oil yield of 438.90 kg ha^{-1} which was on par with Bragg, EC 39824, JW 2750, Ankur, Davis, EC 92814, EC 63298, Monetta and EC 39821 but superior to all other varieties.

But in the second season variety EC 2586 recorded the highest oil yield of 22.70 kg ha^{-1} which was on par with PLSO-18, Improved Pelican, EC 14437 and EC 63298, but superior to all other varieties.

The ranges in oil yield among the varieties tested were 237.02 kg ha^{-1} (PLSO-18) to 438.90 kg ha^{-1} (Improved Pelican) and 10.92 kg ha^{-1} (EC 39824) to 22.70 kg ha^{-1} (EC 2586) in the first and second season respectively.

Comparison between seasons showed that oil yield in second season was markedly less in all the varieties tested.

DISCUSSION

DISCUSSION

The results of the present studies showed wide differences in the performance of soybean in the two seasons. The general growth of the crop was good during the first season and the yield levels were high. During the second season, the growth was very much restricted and the yield was also very low. The reasons for the poor performance of the crop during the second season will be discussed in detail afterwards. As the yield levels are satisfactory only for the first crop, detailed discussion is attempted only for the results of this season.

The results of the first season indicated little difference in the vegetative growth between varieties as indicated by the observations on height of plant, number of branches per plant, number of nodules per plant, number of effective nodules per plant, weight of nodules per plant, total phytomass production per plant and net assimilation rate. Leaf area index also did not differ significantly between varieties except on 90th day. The yield of the crop, on the contrary, showed statistically significant differences and the variety Bragg recorded the highest mean yield of 2319.49 kg/ha. Among the independent yield contributing characters, viz., number of bearing nodes per plant, number of pods per bearing node, number of seeds per pod and test weight, there was significant varietal

difference only in the case of number of pods per bearing node. Simple correlation coefficients between these yield components and the final yield were significant in the case of number of bearing nodes per plant and number of pods per bearing node. The fact that the other two yield components, viz., number of seeds per pod and test weight did not show either statistically significant varietal differences or a significant correlation with yield, may be taken to indicate that these two characters might not have been affected by either varietal or environmental differences. In the case of number of bearing nodes per plant, there was a high positive correlation with seed yield. But the difference in this character between the varieties was not significant. It may be concluded from these results that this character showed wide environmental variations only. Number of pods per bearing node, on the contrary, showed both significant varietal differences and correlation with yield. Thus, the only primary growth component that had significant influence on seed yield was the number of pods per bearing node. Positive correlation between number of pods per plant and seed yield were reported by Saxena and Pandey (1971), Veeraswamy and Rathnaswamy (1975) and Choudhary et al. (1977).

Among the dependent growth contributing characters, shelling percentage showed significant varietal difference. The varietal variations in number of pods per plant and

weight of pods per plant were not significant, though these gave significant correlation with grain yield.

As would be evident from the results on seed yield (Table 12) the yield of the variety Bragg was statistically at par with the yield of all the other varieties excepting EC 92814, EC 14437 and PLSO-18. The range in yield between varieties was from 1338.02 to 2319.49 kg ha^{-1}. As the mean yields of a large number of varieties were statistically at par, an attempt was made to select a few varieties as superior. This was done by selecting the varieties whose yields exceeded the critical level of discrimination. Such a selection showed the superiority of the varieties Bragg, EC 26691, JN 2750, EC 63298 and Monetta. To estimate the genetic potential of the varieties, a selection index based on number of pods per bearing node and number of bearing nodes per plant was calculated and based on this selection index, the varieties were ranked. The variety Bragg came out as superior based on this criterion also. Among the varieties that were selected as superior based on mean yield, the three varieties Bragg, JN 2750 and EC 26691 ranked first, second and third respectively in selection index. These three varieties may therefore be considered as most superior in terms of their genetic potential.

Superiority of the variety Bragg on seed yield had been reported by Saxena and Pandey (1971) among 16 varieties tested and Agarwal and Narang (1975) among three varieties tried. Premsekhar (1973) reported JN 2750 as the highest yielder among 36 varieties.

A study of the comparative growth performance of these three superior varieties may be made by ranking the varieties for each of the growth characters and identifying those in which these three varieties occupy positions within the first five ranks. Such a comparison indicated that Bragg was superior in terms of height, total number of nodules, number of effective nodules, weight of nodules, leaf area index and net assimilation rate. The variety JN 2750 ranked first in height and leaf area index and was superior in number of branches, total number of nodules and weight of nodules. EC 26691 came out as first in number of branches, and was superior in height of plant, number of effective nodules per plant, weight of nodules per plant, leaf area index and net assimilation rate.

As had been indicated earlier, the general growth of all the varieties was good during the first season, and in the case of these superior varieties the highest values of plant height and number of branches ranged from 64.31 to 70.27 cm and 4.20 to 5.67 respectively. Nodules were noticed from the first stage of observation (40 days after sowing) in all the varieties and the highest mean values

on total number of nodules, number of effective nodules and weight of nodules per plant for these superior varieties ranged from 12.265 to 26.079, 5.927 to 6.668 and 0.483 to 0.654 g respectively. The leaf canopies were also dense and the respective LAI values for Bragg, JU 2750 and EC 26691 were 7.767, 8.094 and 6.054 on 90th day after sowing.

Comparison of the contents of fertiliser nutrients in plant parts showed wide variations between varieties and it was difficult to draw any conclusion of the superiority of any of the varieties. Similar significant varietal variation in the content of these nutrients had been reported by Bataglia et al. (1977). But Hanway and Weber (1971b) reported nonsignificant varietal difference in the content of nitrogen, phosphorus and potash in soybean plant parts.

In the case of uptake of nutrients, an indication of higher uptake by superior varieties was evident and the variety Bragg recorded the highest uptake of all the three nutrients at harvest. Variety JU 2750 was second in nitrogen uptake and third in potassium uptake at harvest. Nitrogen and potassium uptake values of EC 26691 were comparatively high. The uptake of nitrogen at harvest by the three superior varieties ranged from 195.034 to 252.401 kg ha^{-1} and those by phosphorus and potassium from 12.142 to 19.442 and 100.042 to 135.364 kg ha^{-1} respectively. These uptake values of phosphorus compare reasonably with the fertilizer

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recommendation for this crop. In the case of potassium, on the contrary, the uptake values are far higher than the present recommendation.

It may also be worthwhile studying the pattern of accumulation of nutrients in the different plant parts. Uptake of the nutrients on 90th day (prior to leaf shedding) indicated concentration of 52 to 56 per cent of the total nitrogen in the leaves in these 3 superior varieties. The comparable figures for stem and pods were 20 to 26 per cent and 21 to 33 per cent respectively. At harvest, the quantities of this nutrient in seeds, shells and stems ranged from 86 to 90 per cent, 6 to 7 per cent and 3 to 5 per cent, respectively. It would appear from these figures that the bulk of nitrogen in plants gets concentrated in seeds and the plant components in the decreasing order of nutrient accumulation were seed, shell and stem at harvest, and leaves, pods and stem on 90th day after planting. A similar comparison made for the phosphorus uptake would indicate the highest accumulation of the nutrient in pods and leaves on 90th day after planting followed by stem. At harvest, the plant components in the decreasing order of importance were seed, shell and stem. In the case of potassium, the bulk of the nutrient was concentrated in stem on the 90th day after sowing. The other components in the decreasing order were leaves and pods and the ranking at harvest was in the sequence, seed, shell and stem.

The protein and oil contents of seeds showed significant varietal differences. Of the three superior varieties, Bragg and JN 2750 recorded relatively high protein contents and the respective values were 35.69 per cent and 34.70 per cent. The protein content of EC 26691 was comparatively low (29.72 per cent). The content of oil in seeds in the varieties tested ranged from 14.09 to 21.30. Percentage of oil in seeds of the superior varieties were comparatively low. The yields of protein and oil, on the contrary, were relatively high in the superior varieties especially in the case of Bragg and JN 2750. The protein yield of the three varieties Bragg, JN 2750 and EC 26691 were respectively 325.65, 772.26 and 667.43 kg ha^{-1}. The corresponding values for oil yield were 428.87, 417.20 and 316.60 kg ha^{-1}. The fact that the high yielding varieties showed higher oil yield also indicates that the total seed yield rather than the content of oil had a dominant influence in deciding the total oil yield.

As had been indicated earlier, the yield of all the varieties during the second season (October 28th to January 27th) was comparatively low. The range in yield was only between 63.90 to 129.00 kg ha^{-1}. A comparison with the observations on growth parameters would show that the plants were much shorter and had less number of branches.

Nodulation was also poorer. Unlike in the first season, the leaf canopies were sparse and the mean LAI ranged from 0.650 to 1.144. Such a poor growth performance of the plant was reflected on the poor expression of yield contributing characters also.

The explanation for poor growth and yield of all the soybean varieties during the second season can be given from a study of the meteorological data of the two seasons. The total rainfall received during the second season was only 180.1 mm as against 3180.2 mm during the first season. The weekly average temperature ranged from 21.17 to 32.4°C for the first season and from 20.40 to 34.03C in the second season. Ranges in the weekly average relative humidity in the first and second seasons were 61.43to 97.14 per cent and 45.4 to 92.2 per cent, respectively. Among all the above weather parameters, the most glaring difference appears to be that of the amount of rainfall received. In addition to the conspicuously lower rainfall received during second season, the distribution was also highly uneven and the rains were restricted almost completely to the initial growth phase of the crop. It appears therefore that the intensity and the distribution of rainfall were probably predominantly responsible for the restricted growth of the crop during the second season.

Another major difference in the performance of the

varieties during this season was that the total crop duration was markedly less during the second season. It took about 125 to 130 days for the varieties to come to maturity during first season, whereas these could be harvested in 83 to 85 days in the second season. The study of the days to flowering (Table 9) would also indicate that both the time required for appearance of flower and the time taken from flowering to maturity were less during the second season. The earlier appearance of flowers during the second season might have been at least partly induced by the shorter day length during this season. Similar results of enhanced flowering in shorter days in soybean have been reported by Byth (1968). Eventhough the decrease in day length might have influenced the period from flowering to maturity as had been reported by Byth (1968) and Whigham (1976), the other environmental restrictions also might be involved in this. Though the yields were comparatively low during the second season, there were significant varietal differences and varieties PLSO-18, EC 2586 and Improved Pelican were ranked first, second and third. The performance of the superior varieties of the first season was comparatively poor during the second season.

SUMMARY

SUMMARY

A field experiment was conducted in the Instructional Farm attached to the College of Horticulture, Vellanikkara during the period from June 1980 to January 1981, to study the performance of soybean varieties during south west and north east monsoon seasons of Kerala. The treatments consisted of 14 soybean varieties viz., EC 39821, EC 14437, EC 26691, Improved Pelican, EC 92814, Ankur, PLS0-18, Monetta, Bragg, EC 39824, Davis, JN 2750, EC 63296 and EC 2586. The experiment was laid out in a randomised block design with three replications. The results are summarised below.

1. There was no significant varietal difference in height of plants, number of branches per plant, number of nodules per plant, number of effective nodules per plant, weight of nodules per plant, total phytomass production per plant and net assimilation rate at any of the growth stages in both the seasons. The varietal effect on leaf area index was significant only on 90th day of first season and the variety JN 2750 recorded the highest LAI value of 3.094. A drastic reduction in the expression of all the growth characters was noticed in the second season compared to the first.

2. Yield contributing factors like number of bearing nodes per plant, number of pods per plant, weight of

pods per plant, number of seeds per pod, 1000 seed weight and harvest index did not show any significant variation between varieties in both the seasons.

3. Varieties showed significant differences in shelling percentage in both the seasons, in number of pods per bearing node in the first season and number of seeds per plant in the second season.

4. Significant varietal difference in seed yield and stover yield were observed in both the seasons. The variety Bragg recorded highest seed yield of 2319.49 kg ha^{-1} in the first season and it was on par with varieties EC 26691, JN 2750, EC 63298, Monetta, Improved Pelican, EC 39824, EC 39821, Davis and Ankur but superior to other varieties. A selection technique based on the normal distribution and selection index could identify the varieties Bragg, JN 2750 and EC 26691 as most promising.

5. Marked varietal difference in stover yield was noticed in both the seasons and the highest stover yield of 3616.45 kg ha^{-1} was recorded by the variety Improved Pelican which was on par with JN 2750, Bragg, EC 39824 and EC 26691 but superior to all other varieties in the first season. All the varieties showed extremely poor performance with regard to yield and yield contributing characters in the second season.

6. There was significant varietal difference in the content of fertiliser nutrients in different plant parts in almost all growth stages. But the uptake of these nutrients did not differ much between varieties. The uptake of the nutrients was conspicuously less in the second season compared to first in all the varieties.

7. Varietal difference in protein content was significant only in the first season and the variety Monetta recorded the highest protein content of 36 per cent. Protein yield, oil content and oil yield differed significantly between varieties in both the seasons. During the first season the varieties Bragg, Ankur and Improved Pelican recorded the highest values of protein yield, oil content and oil yield respectively.

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*Originals not seen

APPENDICES

Appendix - 1

Analysis of variance for height of plant and number of branches per plant

Source	df	First season					Source	df	Second season	
		Mean squares							Mean squares	
		Height of plant			No.of branches per plant				Height of plants	
		40th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing			40th day after sowing	60th day after sowing
Block	2	207.350**	350.660**	201.180	0.720	3.150	Block	2	1.700	14.600
Treat-ment	12	10.620	32.880	42.730	0.710	0.730	Treat-ment	13	3.160	12.910
Error	24	19.260	40.940	77.110	0.490	1.460	Error	26	3.150	8.390

** Significant at 1 per cent level

Appendix - 2

Analysis of variance for number of total root nodules per plant, number of effective nodules per plant and weight of total root nodules per plant.

Source	df	Mean squares							
		Total number of root nodules per plant			Number of effective nodules per plant		Weight of total root nodules per plant		
		40th day after sowing	60th day after sowing	90th day after sowing	60th day after sowing	90th day after sowing	40th day after sowing	60th day after sowing	90th day after sowing
First season									
Block	2	4.191*	11.303	351.306**	1.328	129.277**	0.066*	0.037	1.293**
Treatment	12	1.743	4.403	16. 565	1.374	3.303	0.024	0.124	0.290
Error	24	1.103	9.829	10.686	2.304	10.513	0.015	0.100	0.154
Second season									
Block	2	2.346	0.297		0.840			0.00013	
Treatment	13	1.933	0.862		0.598			0.00036	
Error	26	1.471	2.020		0.666			0.00052	

Appendix - 3

Analysis of variance for the total phytomass production per plant at various growth stages

Source	First season					Second season				
	df	Mean squares				df	Mean squares			
		Phytomass production per plant					Phytomass production per plant			
		40th day after sowing	60th day after sowing	90th day after sowing	Harvest		40th day after sowing	60th day after sowing	Harvest	
Block	2	2.211**	13.154	63.597	75.570	2	0.0160	0.040	0.002	
Treatment	12	0.320	2.641	57.309	40.544	13	0.017	0.109	0.173	
Error	24	0.459	6.306	29.385	31.540	26	0.023	0.177	0.086	

** Significant at 1 per cent level

Appendix - 4

Analysis of variance for leaf area index and net assimilation rate

Source	First season					Second season			
		Mean squares					Mean squares		
		Leaf area index			Net assimilation rate		Leaf area index		Net assimilation rate
	df	40th day after sowing	60th day after sowing	90th day after sowing	Between 40th and 60th day after sowing	Between 60th and 90th day after sowing	df	40th day after sowing	60th day after sowing	Between 40th and 60th day after sowing
Block	2	0.826	4.991	11.578*	0.061	0.650	2	0.025	0.089	0.712
Treatment	12	0.198	1.906	9.826*	2.807	1.946	13	0.034	0.059	0.923
Error	24	0.298	3.070	3.427	3.747	3.079	26	0.046	0.156	0.968

* Significant at 5 per cent level

Appendix - 5

Analysis of variance for number of bearing nodes per plant, number of pods per bearing node, number of seeds per pod and 1000 seed weight.

		First season					Second season			
		Mean squares					Mean squares			
Source	df	Number of bearing nodes per plant	Number of pods per bearing node	Number of seeds per pod	1000 seed weight	df	Number of bearing nodes per plant	Number of pods per bearing node	Number of seeds per pod	1000 seed weight
Block	2	18.575	0.041	0.051	0.820*	2	1.480	0.080	0.431	0.800
Treat-ment	12	22.030	0.726**	0.044	0.210	13	0.980	0.124**	0.440	0.270
Error	24	33.55	0.247	0.030	0.130	26	0.970	0.080	0.262	0.220

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 6

Analysis of variance for number of pods per plant, weight of pods per plant, shelling percentage and number of seeds per plant.

		First season					Second season			
		Mean squares					Mean squares			
Source	df	Number of pods per plant	Weight of pods per plant	Shelling percentage	Number of seeds per plant	df	Number of pods per plant	Weight of pods per plant	Shelling percentage	Number of seeds per plant
Block	2	234.123	36.985	10.795	1553.546	2	3.265	0.002	27.979**	0.180
Treatment	12	436.267	19.254	17.223*	1428.906	13	1.563	0.173	10.724*	11.893*
Error	24	294.629	15.745	5.987	1022.958	26	1.847	0.086	3.403	4.219

* Significant at 5 per cent level

** Significant at 1 per cent level

APPENDIX - 7

Analysis of variance for seed yield, stover yield and harvest index

		First season				Second season		
		Mean squares				Mean squares		
Source	df	Seed yield	Stover yield	Harvest index	df	Seed yield	Stover yield	Harvest index
Block	2	182666.970	279987.353	0.0001	2	1852.51**	1414.710	0.013*
Treat-ment	12	279200.150**	627891.231**	0.0009	13	1124.820*	3180.080*	0.005
Error	24	57676. 64	100867.367	0.0005	26	300.73	564.50	0.002

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 8

Analysis of variance for nitrogen content of stem at different growth stages

Source	First season df	First season Mean squares: Nitrogen content of stem: 40th day after sowing	60th day after sowing	90th day after sowing	Harvest	Second season df	Second season Mean squares: Nitrogen content of stem: 40th day after sowing	60th day after sowing	Harvest
Block	2	0.030	0.003	0.005	0.002	2	0.050	0.020	0.079
Treatment	12	0.027	0.065**	0.039**	0.023**	13	0.062	0.118*	0.254**
Error	24	0.030	0.005	0.003	0.002	26	0.057	0.027	0.042

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 9

Analysis of variance for nitrogen content of leaves at different growth stages

Source	First season df	First season Mean squares: Nitrogen content of leaves 40th day after sowing	First season Mean squares: Nitrogen content of leaves 60th day after sowing	First season Mean squares: Nitrogen content of leaves 90th day after sowing	Second season df	Second season Mean squares: Nitrogen content of leaves 40th day after sowing	Second season Mean squares: Nitrogen content of leaves 60th day after sowing
Block	2	0.002	0.140	0.102	2	0.071	0.008
Treatment	12	0.204**	0.290**	0.563**	13	0.213*	0.865*
Error	24	0.022	0.048	0.105	26	0.085	0.027

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 10

Analysis of variance for nitrogen content of pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Nitrogen content of				Nitrogen content of		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	0.002	0.0001	0.049	2	0.098	0.0026	0.006
Treat-ment	12	0.073**	0.020**	0.304**	13	0.049	0.011**	0.102
Error	24	0.010	0.0009	0.048	26	0.063	0.0019	0.053

** Significant at 1 per cent level

Appendix - 11

Analysis of variance for nitrogen uptake by stem at different growth stages

Source	First season					Second season			
		Mean squares					Mean squares		
		Nitrogen uptake by stem					Nitrogen uptake by stem		
	df	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	df	40th day after sowing	60th day after sowing	Harvest
Block	2	13.762*	124.024	179.550	18.510	2	0.150	4.936	0.0005
Treatment	12	1.897	41.938	390.468*	21.351	13	0.154	3.961	1.047
Error	24	3.012	51.969	99.870	14.160	26	0.295	2.075	0.238

* Significant at 5 per cent level

Appendix - 12

Analysis of variance for nitrogen uptake by leaves at different growth stages

Source	First season df	First season Mean squares: Nitrogen uptake by leaves 40th day after sowing	First season Mean squares: Nitrogen uptake by leaves 60th day after sowing	First season Mean squares: Nitrogen uptake by leaves 90th day after sowing	Second season df	Second season Mean squares: Nitrogen uptake by leaves 40th day after sowing	Second season Mean squares: Nitrogen uptake by leaves 60th day after sowing
Block	2	33.790	925.500	211.783	2	0.510	3.082
Treatment	12	15.029	195.562	2021.544*	13	1.548	5.183
Error	24	14.170	311.026	839.989	26	1.577	8.190

*Significant at 5 per cent level

Appendix - 13

Analysis of variance for nitrogen uptake by pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	1.804	69.147	7390.194	2	0.018	0.007	19.005
Treatment	12	5.253*	27.410	5630.035	13	0.041	0.160	16.083*
Error	24	1.700	24.148	3614.917	26	0.092	0.129	6.048

* Significant at 5 per cent level

Appendix - 14

Analysis of variance for total nitrogen uptake by plant at different growth stages

Source	df	First season				df	Second season		
		Mean squares					Mean squares		
		Nitrogen uptake by plant					Nitrogen uptake by plant		
		40th day after sowing	60th day after sowing	90th day after sowing	Harvest		40th day after sowing	60th day after sowing	Harvest
Block	2	127.277*	1752.289	2582.370	9705.838	2	3.952	18.310	18.857
Treat-ment	12	27.569	375.825	5297.63*	6487.489	13	3.079	12.930	20.434*
Error	24	24.004	598.804	1953.17	4555.642	26	3.358	19.000	6.713

*Significant at 5 per cent level

Appendix - 15

Analysis of variance for phosphorus content of stem at different growth stages

Source	First season					Second season			
	df	Mean squares				df	Mean squares		
		Phosphorus content of stem					Phosphorus content of stem		
		40th day after sowing	60th day after sowing	90th day after sowing	Harvest		40th day after sowing	60th day after sowing	Harvest
Block	2	0.0002	0.00004	0.00005	0.0001*	2	0.000014	0.0001	0.0005
Treatment	12	0.023**	0.0217**	0.0084**	0.0001**	13	0.00013**	0.0017**	0.004
Error	24	0.0014	0.0006	0.00003	0.00002	26	0.0002	0.0002	0.0005

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 16

Analysis of variance for phosphorus content in leaves at different growth stages

Source	First season				Second season	
	df	Mean squares			df	Mean squares
		Phosphorus content of leaves				Phosphorus content of leaves
		40th day after sowing	60th day after sowing	90th day after sowing		40th day after sowing	60th day after sowing
Block	2	0.0002	0.003	0.010	2	0.0002	0.0001
Treatment	12	0.0589**	0.0288**	0.0320**	13	0.0030**	0.0020**
Error	24	0.0010	0.0006	0.008	26	0.0001	0.0001

** Significant at 1 per cent level

Appendix - 17

Analysis of variance for phosphorus content in pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Phosphorus content				Phosphorus content		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	0.0006	0.00001	0.0236**	2	0.0006	0.0002	0.00005
Treat-ment	12	0.0016*	0.0018**	0.0184**	13	0.0006	0.0019**	0.0020
Error	24	0.0007	0.0001	0.0017	26	0.0007	0.0006	0.0010

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 18

Analysis of variance for phosphorus uptake by stem at different growth stages

Source	First season df	First season Mean squares: Phosphorus uptake by stem: 40th day after sowing	60th day after sowing	90th day after sowing	Harvest	Second season df	Second season Mean squares: Phosphorus uptake by stem: 40th day after sowing	60th day after sowing	Harvest
Block	2	1.373*	6.588	0.161	0.051	2	0.0005	0.0012	0.00004
Treatment	12	0.503	2.017	0.663**	0.080	13	0.0008*	0.0069	0.0002
Error	24	0.383	2.666	0.164	0.040	26	0.0004	0.0057	0.0002

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 19

Analysis of variance for phosphorus uptake by leaves at different growth stages

Source	First season df	First season Mean squares: Phosphorus uptake by leaves			Second season df	Second season Mean squares: Phosphorus uptake by leaves	
		40th day after sowing	60th day after sowing	90th day after sowing		40th day after sowing	60th day after sowing
Block	2	1.886*	9.965	1.283	2	0.002	0.005
Treatment	12	1.569**	2.278	1.281	13	0.004	0.014
Error	24	0.484	5.210	2.868	26	0.003	0.014

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 20

Analysis of variance for phosphorus uptake by pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Phosphorus uptake				Phosphorus uptake		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	13.955	0.262	90.432*	2	0.0003	0.016	0.010
Treatment	12	12.194	0.268	22.628	13	0.0006	0.008	0.124
Error	24	11.036	0.127	26.395	26	0.0008	0.0108	0.050

* Significant at 5 per cent level

Appendix - 21

Analysis of variance for phosphorus uptake by plant at different growth stages

Source	df	First season				df	Second season		
		Mean squares					Mean squares		
		Phosphorus uptake by plant					Phosphorus uptake by plant		
		40th day after sowing	60th day after sowing	90th day after sowing	Harvest		40th day after sowing	60th day after sowing	Harvest
Block	2	5.644*	32.247	16.540	101.925	2	0.004	0.011	0.031
Treat-ment	12	3.676	6.690	15.052	20.519	13	0.007	0.053	0.088
Error	24	1.746	14.510	14.727	30.672	26	0.005	0.056	0.048

* Significant at 5 per cent level

Appendix - 22

Analysis of variance for potassium content in stem at different growth stages

Source	First season					Second season				
		Mean squares					Mean squares			
		Potassium content in stem					Potassium content in stem			
	df	40th day after sowing	60th day after sowing	90th day after sowing	Harvest	df	40th day after sowing	60th day after sowing	Harvest	
Block	2	0.0330	0.0001	0.0002	0.0002	2	0.0221	0.0018	0.0011	
Treatment	12	0.3280*	0.1240*	0.0668*	0.1260**	13	0.1648**	0.0943**	0.0194**	
Error	24	0.0450	0.0070	0.0075	0.0012	26	0.0131	0.0152	0.0023	

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 23

Analysis of variance for potassium content in leaves at different growth stages

Source	df	First season			df	Second season	
		Mean squares				Mean squares	
		Potassium content in leaves				Potassium content in leaves	
		40th day after sowing	60th day after sowing	90th day after sowing		40th day after sowing	60th day after sowing
Block	2	0.005	0.017	0.008	2	0.020	0.006
Treatment	12	0.442**	0.071**	0.036**	13	0.207**	0.024
Error	24	0.039	0.017	0.004	26	0.040	0.012

** Significant at 1 per cent level

Appendix - 24

Analysis of variance for potassium content in pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Potassium content				Potassium content		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	0.011	0.008	0.0013	2	0.005	0.016	0.0034
Treatment	12	0.018	0.343**	0.0406**	13	0.035*	0.046**	0.0674**
Error	24	0.013	0.017	0.0043	26	0.015	0.013	0.0117

* Significant at 5 per cent level

** Significant at 1 per cent level

Appendix - 25

Analysis of variance for potassium uptake by stem at different growth stages

Source	First season df	First season Mean squares: Potassium uptake by stem – 40th day after sowing	60th day after sowing	90th day after sowing	Harvest	Second season df	Second season Mean squares: Potassium uptake by stem – 40th day after sowing	60th day after sowing	Harvest
Block	2	75.859*	553.457	780.256	74.163	2	0.238	0.119	0.177
Treatment	12	11.735	157.777	750.383*	69.646*	13	0.105	1.202	0.202
Error	24	16.300	207.968	317.872	29.370	26	0.297	0.868	0.150

* Significant at 5 per cent level

Appendix - 26

Analysis of variance for potassium uptake by leaves at different growth stages

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Potassium uptake by leaves				Potassium uptake by leaves		
		40th day after sowing	60th day after sowing	90th day after sowing		40th day after sowing	60th day after sowing	
Block	2	16.693	38.490	79.164	2	0.160	1.145	
Treat-ment	12	8.798	20.999	299.562*	13	0.408	0.979	
Error	24	8.870	42.650	101.601	26	0.479	1.811	

* Significant at 5 per cent level

Appendix - 27

Analysis of variance for potassium uptake by pods, shells and seeds

Source	First season				Second season			
	df	Mean squares			df	Mean squares		
		Potassium uptake				Potassium uptake		
		Pods	Shells	Seeds		Pods	Shells	Seeds
Block	2	1.612	184.898	796.734	2	0.027	0.0015	0.168
Treatment	12	2.029	265.720*	476.447	13	0.028	0.014*	2.963*
Error	24	1.601	93.842	343.285	26	0.032	0.006	1.046

* Significant at 5 per cent level

Appendix - 28

Analysis of variance for potassium uptake by plant at different growth stages

Source	df	First season				df	Second season		
		Mean squares					Mean squares		
		Potassium uptake by plant					Potassium uptake by plant		
		40th day after sowing	60th day after sowing	90th day after sowing	Harvest		40th day after sowing	60th day after sowing	Harvest
Block	2	163.767*	874.210	2198.849	2687.747	2	0.775	1.818	0.230
Treat-ment	12	26.906	276.935	2757.509	1528.710	13	0.635	5.098	8.136*
Error	24	42.327	408.768	1459.891	982.641	26	1.437	6.688	2.811

* Significant at 5 per cent level

Appendix - 29

Analysis of variance for protein content, protein yield, oil content and oil yield

	First season				Second season				
		Mean squares				Mean squares			
Source	df	Protein content	Protein yield	Oil content	Oil yield	df	Protein content	Protein yield	Oil content	Oil yield
Block	2	1.936	30140.960	0.456	7880.68	2	0.192	150.825*	0.0013	59.493**
Treat-ment	12	11.902**	41311.53*	18.202**	12720.43*	13	3.128	123.011**	0.0181**	0.484**
Error	24	1.871	9565.040	3.357	4487.74	26	1.991	33.065	0.0015	8.814

* Significant at 5 per cent level

** Significant at 1 per cent level

COMPARATIVE PERFORMANCE OF SOYBEAN (*Glycine max* (L.) Merrill) VARIETIES

BY

PUSHPAKUMARI, R.

ABSTRACT OF A THESIS

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for the degree of

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COLLEGE OF HORTICULTURE

Vellanikkara - Trichur

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ABSTRACT

An experiment was conducted in the Instructional Farm attached to the College of Horticulture, Vellanikkara, during the period from June 1980 to January 1981 to select soybean varieties suitable for the agroclimatic conditions of Kerala. The experiment was laid out in randomised block design with 14 varieties and three replications.

The study revealed that there was no significant varietal difference in the expression of all growth characters and most of the yield contributing factors at any of the growth stages in both the seasons. But significant varietal differences in seed yield and stover yield were observed in the two seasons. The results of the experiment revealed that the varieties Bragg, JN 2750 and EC 26691 are most promising for the south west monsoon season of Kerala.

The variety Monetta gave the highest protein content of 36 per cent and Bragg, Ankur and Improved Pelican respectively recorded the highest protein yield, oil content and oil yield in the south west monsoon season.

The study further revealed that soybean cannot be successfully grown during north east monsoon season of Kerala without irrigation.