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ANNUAL REPORT

INDIAN GRASSLAND AND FODDER RESEARCH INSTITUTE, JHANSI.

1965

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1. Introduction:

Historical:

Sporadic research work on grasses and fodder crops has been going on in the country for the last several decades. Preliminary studies on the subject were initiated in the former Bombay State as early as the close of the nineteenth Century. Similar work was taken up in Madras, the former Central Provinces, Bengal, Punjab, as also at the Indian (then Imperial) Agricultural Research Institute. The Indian (then Imperial) Council of Research, established on the recommendation of the Royal Commission on Agriculture in India (1928*) stimulated wider interest in the subject by financing research schemes on the subject. Schemes on fodders and grasses have been in progress in recent years at the Indian Agricultural Research Institute (New Delhi), Rajendranagar (Andhra Pradesh). Dumraon (Bihar), Coimbatore (Madras), Poona (Maharashtra), Mandya and Dharwar (Mysore) and Haringhata (West Bengal), Palampur (Punjab), Anand (Gujarat), Bangalore (Mysore). Animal nutrition studies have also besn underway at IVRI (Izatnagar), Mathura (U. P.) and N.D.R.I. (Karnal) as Departmental activity.

Although useful results emerged from these studies and some promising grasses and fodder were selected and introduced in cultivators fields, these studies generally remained restricted in scope and un-co-ordinated. For example, studies on improvement through hybridisation, on nutritive value of fodders and on seed production received inadequate attention, and little work was done on grassland management and forage conservation. Recognition of the importance of grasses and fodders in the agricultural economy of the country, the widening gap between supply and demand of forage necessary for animal production, the limitations of the previous studies, the diversity and the complexity of the problems, and the inadequacy of the exisiting

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*Government of India (1928). Abridged Report of Royal Commission on agriculture in India, presided over by Lord Linlithgow. Govt. Central Press, Bombay.

organisation undertaking such studies as a subsidiary activity, led to the realisation of the need for the establishment of the Indian Grassland and Fodder Research Institute. The scheme for the establishment of the Institute, with its net work of regional stations and sub-centres, was thus prepared for inclusion in the Third Five Year Plan. The Scheme was approved by the Planning Commission in July, 1961, at an estimated cost of Rs. 45 lakhs in the Third Plan period. It was envisaged that the Institute with its regional stations and sub-centres should carry out research on all aspects of the production and utilisation of grasses and fodders, and co-ordinate studies and initiate training programme on the subject.

Shri P. M. Dabadghao was appointed Special Officer for for taking necessary advance action for the establishment of the Institute. He joined on November 1, 1962. An area of 1421 acres (575 ha.), situated at a distance of about 8 km. from Jhansi town on Jhansi-Gwalior Road at the Livestock-cum Agricultural Farm, Bharari (Jhansi), was acquired from the U. P. State Government, on December 24, 1962. Nucleus staff comprising of Ecologist, Farm Superintendent, and ancillary field and ministerial staff were added during 1963 to 1965. The Director of the Institute joined on November 11, 1965.

As a necessary adjunct to the development of the farm and to the under-taking of research programme, action was initiated on contour survey, soil and soil-fertility survey and vegetation survey, as also for the establishment of an agri-meteorological observatory. After the procurement of herbage material, farm equipment and store articles, preliminary research activities were started on grassland management and fodder agronomy in 1964-65. Autecological studies on important grasses of the tract and fertilizer experiments on grassland were initiated. Varietal and manurial trials on cowpeas and graminaceous fodder were conducted. A beginning was also made in the collection of indigenous and exotic material for establishment and maintenance in a plant introduction garden. These activities were continued in the year under report.

Objective:

The objectives of the Institute *inter-alia* are:

i) To carry out research both of fundamental and applied nature on grasses, grasslands and fodder crops as related to animal nutrition, soil fertility, crop production and soil and water conservation.

ii) To collect, co-ordinate and collate research work on the subject in the country by centralising direction, operation and superintendence.

iii) To find out solutions to various confronting problems with regard to grassland and fodder crops, which can be given practical application under the existing social and economic conditions.

iv) To disseminate knowledge of the subject through organised training courses.

Organisational structure and changes:

The Scheme for the establishment of Indian Grassland and Fodder Research Institute, as originally approved, was planned to include (a) the main Institute at Jhansi and (b) six regional stations. The main Institute was planned to be organised into five technical Divisions viz., (i) Plant Improvement, (ii) Grassland Management, (iii) Fodder Agronomy, (iv) Plant-Animal relationship and (v) Weed Ecology and Control, in addition to the adminstrative and general sections. Each technical Division was to be under the control of a Head of the Division. It was envisaged that the regional stations will be set up under Institute initially for development and pilot project studies and later for research to tackle the regional problems requiring solution.

The original scheme accorded low priority to reasearch at Jhansi. The Project has since been re-orientated and it has been decided that the scope of the regional stations may be restricted

to development and demonstrations under the Department of Agriculture (Ministry of Food and Agriculture) and the pace of research at the Institute may be accelerated. It has also been decided that the administrative control of the Institute at Jhansi may be transferred by the Government of India to the Indian Council of Agricultural Research, with effect from April 1, 1966.

During the year under report, the Institute continued to function with the nucleus staff only under the Department of Agriculture (Ministry of Food and Agriculture).

Visitors:

A. The following visited the Institute during the year:

1. Shri Shah Nawaz Khan, Deputy Minister for Agriculture, Ministry of Food and Agriculture, Government of India.

2. Dr. A. N. Ghosh, Fodder Development Officer, Patna (Bihar).

3. Shri S. K. Ranjan, Officer-in-Charge, Pasture and Forage Division, Department of Animal Nutrition, U. P. College of Veterinary Science and Animal Husbandry, Mathura (U. P.).

4. Dr. R. O. Whyte, F. A O. Grassland Adviser to the Government of India.

5. Mr. C. K. Vears, Project Manager Designate UNSF Project for Grassland and Fodder Development.

6. Shri S.N. Mohan, Deputy Dairy Development Adviser to the Government of India.

B. The following officers of the Government of India visited in connection with the constructional programme of the Institute:

1. Shri N. S. Sreekantiah, Deputy Secretary to the Government of India.

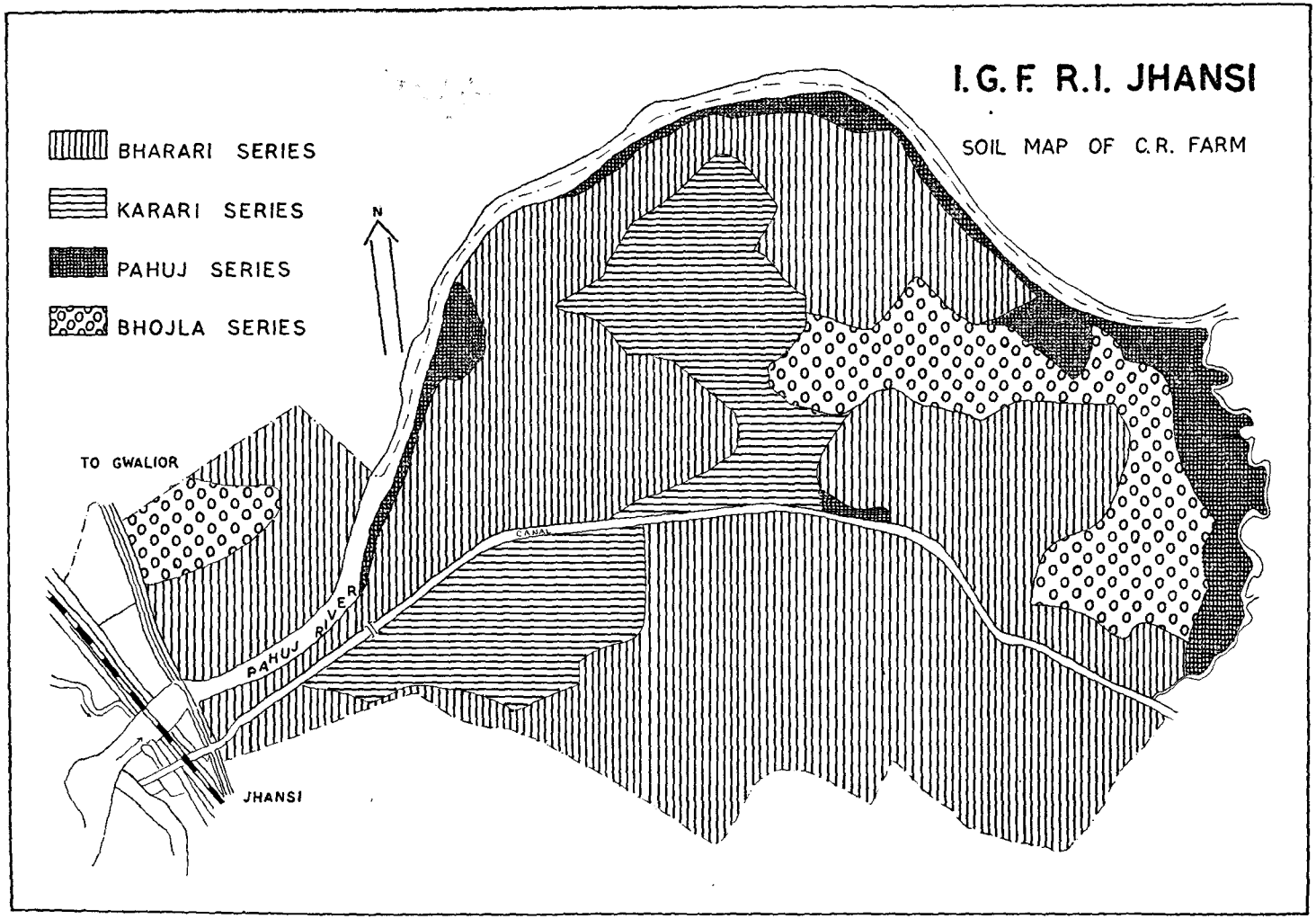
I.G.F. R.I. JHANSI
SOIL MAP OF C.R. FARM
BHARARI SERIES
KARARI SERIES
PAHUJ SERIES
BHOJLA SERIES
N
TO GWALIOR
CANAL
PAHUJ RIVER
JHANSI

Fig. 1

2. Shri V. M. Pundlik, Senior Architect, C.P.W.D., New Delhi.
3. Shri R. G. Gokhale, Superintending Engineer, C. P. W. D., Agra.
4. Shri I. D. Mathur, Executive Engineer, C. P. W. D., Gwalior.
5. Shri H R. Laroya, Architect, C. P. W. D , New Delhi.

Important events of the year:

Apart from the general farm development activities by the Institute, necessary basic surveys of the Central farm were undertaken by the sister organizations of the Government of India for the Institute. Soil survey of the Farm was completed by the All India Soil and Land Use Survey Organization, New Delhi. Soil map of the farm is given in Figure 1.

Soil samples were collected by the Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, for preparation of soil fertility map.

Contour survey of 80 hectares of the farm was completed by the staff of the Central Soil Conservation Research Demonstration-cum-Training Centre, Kota.

The staff of C. P. W D., Gwalior surveyed the Military Padav area for the preparation of Master Plan for the administrative, laboratory and the residential buildings of the Institute.

The architect, C. P W. D', prepared sketch drawings of the farm buildings. Administrative approval was accorded by the Ministry of Food and Agriculture for the construction of an approach road to the site for farm buildings.

Research collaboration with Institutes, Universities, Colleges and other Institutes at national level:

As the Institute was still in initial stages of development, no inter-institutional collaborative research programme was undertaken during the year.

Research collaboration at International level:

Simultaneously with the approval of the scheme for the establishment of the Institute in the Third Five Year Plan, a request was made by the Government of India for U.N.S.F. assistance in developing an intensive programme of fodder development and research. The U. N. S. F. Project was approved by the governing Council of the U. N. S. F. at its 13th Session held in January, 1965. The Project Manager, designate Mr. C. K. Years remained in India during the year. The Project is proposed to be implemented with suitable modifications and has since been re-orientated as mentioned earlier.

Advisory services:

Information on technical matters pertaining to the cultivation of grasses and fodders was given to ten parties who sought such advice.

Extension:

As a part of extension activity the seeds of the following fodder crops were supplied to the various States and private agencies during the year:

	Quantity Q.	Kg.	To whom supplied
M. P. Chari seed	15	35	State Animal Husbandry Deptt (U.P.), Lucknow.
Cowpea seeds	9	00	——do——
....	0	38	Southern Regional Station, National Dairy Research Institute, Bangalore
Oats seed	9	92	State Animal Husbandry Deptt. (U. P.), Lucknow.
Berseem seeds	17	63	——do——

Finance Research Funds and Expenditure:

The details of sanctioned budget and the expenditure incurred during the year ending March, 1966 are given below:

Sub	1966-67		
B-Agril. Expt. and Research B-6 Estt. of Institute of Forage and Grassland Researches	Budget Estimate (Revised)	Actual	Actual for Third Plan
B-5 (1) Pay of Officer	34,400	34,698.20	77,418.83
B-5 (2) Pay of Estt.	19,300	19,303.70	54,358.48
B-5 (3) Allow. & Hono.	17,600	17,428.55	34,031.78
B-5 (4) Other charges	88,400	85,201.37	3,66,961.97
Total....	1,59,700	1,57,631.82	5,32,771.06

2. **Progress of Research:**

Weather conditions:

The Winter and Summer seasons were normal but the rainy season was not favourable for the *Kharif* crops. Although a total of 713.3 mm of rain was received during the season, the delayed onset of the monsoon resulted in late sowings which could only be completed in early August. A prolonged drought period immediately after sowing, followed by poorly distributed rain in August, considerably affected the establishment of the crops. However, the well-distributed and fairly heavy rains amounting to 425 mm received in September helped the crops as well as the grass appreciably.

Researches in Hand:

As in the previous year, the research activity was confined to the two Divisions, namely: 1) Grassland Management and 2) Fodder Agronomy.

A. DIVISION OF GRASSLAND MANAGEMENT

The studies included (i) survey and mapping of the natural vegetation of the Institute farm, (ii) autecological studies on grasses of the tract, (iii) root ecology of common grass species, (iv) grassland manuring, and (v) introduction of legumes in *Heteropogon* grassland.

Amongst the results of practical value, mention may be made of the high response to nitrogen and phosphate in low lying grassland, well supplied with moisture. The results of the different projects are described below:

Project 1: Survey and mapping of the natural vegetation of the Central Research Farm.

(K. A. Shankarnarayan, P.M. Dabadghao and S.P. Marwaha).

The ecological survey covered two types of vegetation, viz., a) Grassland and b) Trees and shrubs. The survey was completed and the vegetation maps were prapared.

a) Grassland vegetation:

The important grass communities together with the edaphic conditions based on soil survey conducted by All India Soil and Land Use Survey Organization are given in Table 1.

There were seven principal grass species, namely *Sehima nervosum, Heteropogon contortus, Chrysopogon fulvus. Bothriochloa pertusa, Themeda quadrivalvis, Iseilema laxum* and *Dichanthium annulatum,* which occurred in varying combinations in 11 grass communities under the *Sehima-Dichanthium* cover.

Besides these, there were three other grasses namely *Saccharum spontaneum, Vetiveria zizaniodes* and *Coix lacrymajobi* the combination of which formed four communities as elements of *Phragmites-Saccharum-Imperata* cover. A map showing the grass communities is given in Fig. 2.

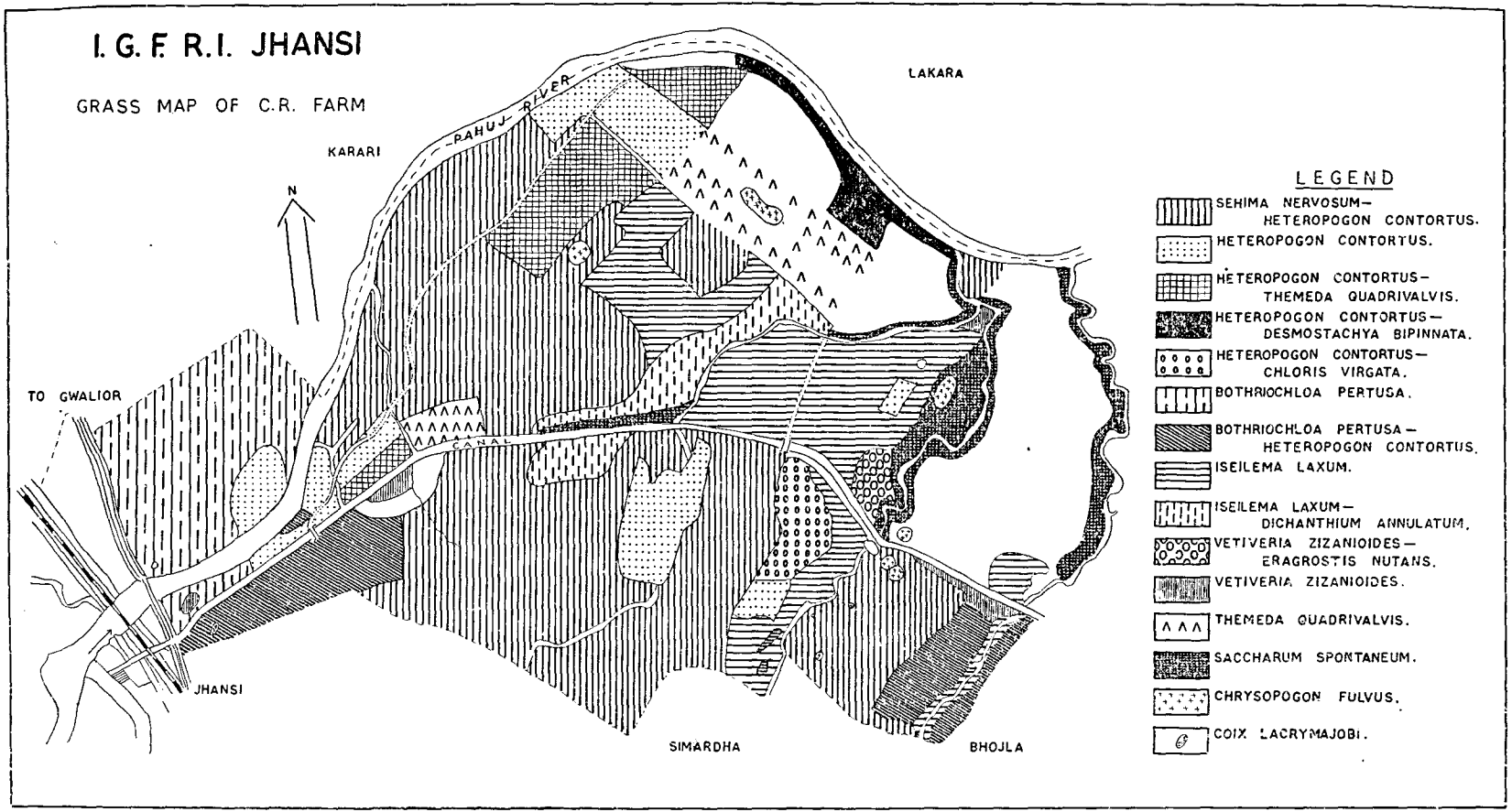
I. G. F. R. I. JHANSI
GRASS MAP OF C.R. FARM
KARARI
PAHUJ RIVER
LAKARA
N
TO GWALIOR
CANAL
JHANSI
SIMARDHA
BHOJLA
LEGEND
SEHIMA NERVOSUM— HETEROPOGON CONTORTUS.
HETEROPOGON CONTORTUS.
HETEROPOGON CONTORTUS— THEMEDA QUADRIVALVIS.
HETEROPOGON CONTORTUS— DESMOSTACHYA BIPINNATA.
HETEROPOGON CONTORTUS— CHLORIS VIRGATA.
BOTHRIOCHLOA PERTUSA.
BOTHRIOCHLOA PERTUSA— HETEROPOGON CONTORTUS.
ISEILEMA LAXUM.
ISEILEMA LAXUM— DICHANTHIUM ANNULATUM.
VETIVERIA ZIZANIOIDES— ERAGROSTIS NUTANS.
VETIVERIA ZIZANIOIDES.
THEMEDA QUADRIVALVIS.
SACCHARUM SPONTANEUM.
CHRYSOPOGON FULVUS.
COIX LACRYMAJOBI.

Fig. 2

b) **Tree and shrub vegetation:**

As a result of survey of the tree and shrub vegetation by Ocular method, 41 plant communities were distinguished at the Central Research Farm.

Project 2: **Autecological studies on important grasses of the tract.**

(K. A. Shankarnarayan and S. P. Marwaha).

A. **Germination studies:**

The seeds of three species (*Sehima nervosum*, *Heteropogon contortus* and *Chrysopogon fulvus*) were subjected to four light treatments, namely: 1) continuous light 2) continuous darkness in chamber 3) diffused light 4) continuous light for 12 hours and continuous darkness for 12 hours. There were no effects of differential light treatments on the germination of the three grasses.

B. **Pot culture studies:**

Pot culture studies were undertaken to asses the response of the three grass species (*Sehima nervosum*, *Heteropogon contortus* and *Chrysopogon fulvus*) to four moisture levels given below on three soil types (fine textured black, gravelly red and grey sandy loam):

Wet: Irrigation at field capacity.

Moist: Irrigation at 75 percent field capacity.

Semi-dry: Irrigation at 50 percent field capacity.

Dry: Irrigation at 25 percent field capacity.

Treatment effects on dry weight of grasses are given in Table 2.

Table: Response of different grass species to varying water regimes: yield in gm.

Name of species	MOISTURE REGIME				SOIL TYPE			
	Wet	Moist	Semi-Dry	Dry	Fine textured black	Gravelly red	Sandy loam	Mean
Sehima nervosum	75.7	50.7	34.0	21.7	94.0	47.3	40.7	60.7
Chrysopogon fulvus	34.0	28.3	26 8	16.0	34.3	36.7	34.2	35.7
Heteropogon contortus	147.7	177.3	102.7	80.7	194.3	179.7	151.0	175.0
Mean ...	85.8	85.4	54.5	39.5	107.5	87.9	75.3	....

Heteropogon contortus produced the highest and *Chrysopogon fulvus* the lowest dry matter and *Sehima nervosum*, occupied intermediate position. The dry weight of the grasses increased with improvement in the moisture status of the soil. Moisture regime (irrigation at 75 per cent field capacity) appeared to be optimum for *H. contortus*. *S. nervosum* and *C. fulvus* were responsive to still moisture conditions. It seemed that the performance of *C. fulvus* was not influenced by soil type but the others were at their best on the fine-textured black soil.

It may be mentioned that in nature *S. nervosum* occurs on red gravelly soil, *C. fulvus* on shallow rocky soil and *H. contortus* has wider adaptability. The autecological studies mentioned above also pointed to the wider ecological amplitude of *H. contortus* and the specific preference of *S. nervosum* and *C. fulvus* to moister habitats.

Project 3: **Root ecology of common grass species of the tract:**

(K. A. Shankarnarayan, P. M. Dabadghao and S. P. Marwaha)

A study of the underground organs of the perennial grasses is necessary for the proper interpretation of their behaviour in a given environment. Such a study also throws light on their distribution in Nature. The studies on root development were undertaken by trench washing method (Upchurch and Lovvorn, 1951*) on five principal grass species, viz., *Sehima nervosum, Heteropogon contortus, Iseilema laxum, Dichanthium annulatum* and *Chrysopogon fulvus*. The root characters of nine-month old plants, spaced 2m x 2m, are given in Table 3 for each of the species under study:

Table 3: **Root characters of 9-month old plant (spaced at 2m x 2m).**

	Number of roots	Root Diameter in mm.	Max. Depth in cm.	Quantity of root matter added to soil (q/ha)
1. *Sehima nervosum*	544	0·51	149	14·44
2. *Heteropogon contortus*	633	0·69	136	15·60
3. *Iseilema laxum*	719	0·19	105	16·67
4. *Dichanthium annulatum*	778	0·58	98	29 05
5. *Chrysopogon fulvus*	225	0·61	68	3·94

*Upchurch, R.P., and R. L. Lovvorn. Gross morphological root habits of alfalfa in North Carolina. Agron. Jour. 43: 493-498. 1951.

D. annulatum had the maximum number of roots and also produced maximum root material thus indicating its potentiality for improving the structure. *I. laxum* with its large numbers of thin roots indicated a superior soil binding ability. *S. nervosum* and *H. contortus* showed deep root system pointing to their inherent drought resistance capacity. *C. fulvus* generally showed a shallow rooting habit and poorly developed root system in comformity with its dominance on shallow rocky soil and indicating its intrinsic unsuitability for deep clay soils.

Project 4: **Grassland manuring:**

(K. A. Shakarnarayan and S. P. Marwaha)

Two sets of factorial trials, one on Heteropogon and the other on low-lying grassland of *Iseilema* were conducted to study the effect of three levels of nitrogen (0,20, 40 Kg. N/ha) two levels of phosphate (0,20 Kg. P_2O_5/ha) and two levels of potassium (0,20 Kg. K_2O/ha). These experiments which were initiated in 1964 were repeated during the year on the same site without altering the position of the treatments. The fertilizer dressings were applied afresh on June 24, 1965 and therefore, the responses of treatments recorded during the year represented cumulative effects.

Table 4: **Effect of nitrogen, phosphate and potassium on the yield of dry grass (q/ha).**

(a) **Heteropogon contortus:**

	Mean over k_0 and k_1		Mean over p_0 and p_1		Mean ±1·34
	p_0	p_1	k_0	k_1	
n_0	20·46	27·51	23 39	24·58	23 99
n_1	26·96	32·95	33·30	26 60	29 95
n_2	23·07	25·58	25·19	23·46	24·32
Mean ±1·09	23·50	28·68	27·29	24·88	

(b) **Low lying grassland (Iseilema laxum) :**

	Mean over k_0 and k_1		Mean over p_0 and p_1		Mean
	p_0	p_1	k_0	k_1	
n_0	38·32	42 69	42·95	38·05	40·50
n_1	39·60	52·72	43·44	48·89	46·16
n_2	52·63	58·95	55·83	55·75	55·79
Mean ±1·36	43·52	51·45	47·41	47 56	

C D at 5% level = 5·25, 6·51 ql/ha for responses to P and N (linear) respectively.

n_0, n_1, n_2 represent 0,20,40 Kg. N/ha respectively.

p_0, p_1 represent 0,20 Kg. P_2O_5/ha respectively.

k_0, k_1 represent 0,20 Kg. K_2O/ha respectively.

In *Heteropogon* grassland (Table 4a), nitrogen and phosphate at 20 Kg. N and 20 Kg. P_2O_5 respectively tended to increase the yield of grass. The response to the higher level of nitrogen and potassium were not discernible. During the previous year the responses to the single and the double dressing of nitrogen were 26 per cent and 92 per cent respectively. The low responses in 1965 were probably the result of sub-normal and delayed rains, inasmuch as moisture acted as a limiting factor.

In lowlying grassland with *Iseilema laxum* and *Dichanthium annulatum* as the dominant species, well supplied with moisture (Table 4b), 40 Kg. N/ha and 20 Kg. P_2O_5 gave the highest yields. The single and the double dressing of

nitrogen increased the yield by 13 7 per cent and 36·8 per cent respectively. The corresponding increases in the preceding year when rainfall distribution was favourable, were 42.1 per cent and 65·8 per cent.

Project 5 : **Introduction of legumes in Heteropogon grassland :**

(K. A. Shankarnarayan, P. M. Dabadghao and S. P. Marwaha)

Legumes are an important constituent of grasslands in agriculturally advanced countries and contribute substantially to the nutritive value of herbage and the productivity of the grasslands. The legume component is practically absent in the natural grasslands in India. It is to be expected that a successful introduction of a legume would improve the quality of these grasslands. Preliminary studies were, therefore, started with a view to finding out the best method of establishment of *Atylosia scarabaeoides*, which is a local palatable legume, by over-seeding it in *Heteropogon* grassland. The treatments included the following :

(a) time of sowing (January, May and July)

(b) seed rate (0,50,75 and 180 gms. per plot of size (1/200 ha).

(c) harrowing (with and without).

The results showed encouraging establishment when over-seeding was done in the pre-monsoon season. Harrowing seemed to improve the chances of establishment.

B. DIVISION OF SOIL SCIENCE AND AGRONOMY

Agronomic experiments on fodder crops were conducted to study : (i) the scope and efficacy of introduction of *Vicia* in wheat to improve the nutritive value of wheat *bhusa*, (ii) the effect of N, P, K on the yield of MP *Chari*, (iii) comparative performance of various graminaceous fodder crops, (iv) comparative performance of cowpeas varieties, (v) the effect of seed rate and spacing in MP *Chari*.

The experiments indicated good prospects of introducing Vetch in wheat to improve the nutritive value of wheat straw. Promising performance of 'sudax' and cowpeas No. 9 (Durgapura) was indicated in the comparative yield trials. The results obtained in the different projects were as follow :

Project 1 : **Introduction of Vetch in Wheat :**

(P. M. Dabadghao, S. P. Marwaha and R. K. Pandey)

These studies were started with a view to improving the nutritive value of *bhusa* by growing Vetch in association with wheat, inasmuch as Vetch hay is simultaneously incorporated with the wheat straw at the time of the harvest of wheat. The treatments included five increasing levels of seed rates of Vetch in a wheat crop ; pure wheat served as the 'control'. The yield of wheat grain and the nutritive value of wheat straw in terms of protein, calcium and phosphorus contents under the different treatments are given in Table 5.

Table 5 : **Yield of Wheat and Nutritive value of Bhusa.**

Sl. No.	Treatments	Yield of wheat in q/ha	Crude protein per cent	Calcium per cent	Phosphorus per cent
1	Wheat + Vetch (70 Kg /ha)	18·91	5·18	0·45	0·15
2	Wheat + Vecth (56 Kg./ha)	19·66	4·63	0·36	0·15
3	Wheat + Vetch (42 Kg./ha)	20·36	3·26	1·27	0·12
4	Wheat + Vetch (28 Kg./ha)	19·86	3·33	0·26	0·13
5	Wheat + Vetch (14 Kg./ha)	17·74	3·11	0 22	0·11
6	Pure Wheat (75 Kg./ha)	19·64	3·25	0·20	0·11

Statistical analysis did not show any significant differences in the yields of wheat grain from the plots under mixed sowing

as compared to those under pure wheat. This indicated that normal grain yields of the crop were obtained, even when the crop was grown mixed with Vetch. Chemical analysis of *bhusa* showed that as a result of mixed sowing, there was a general improvement in its nutritive value, in terms of crude protein, Ca and P content.

Project 2 : **The effect of N, P and K on the MP Chari.**

(S. P. Marwaha and R. K. Pandey)

The treatment under the experiment comprised of three levels of nitrogen (0,25,50 Kg. N/ha), two levels of phosphate (0,25 Kg. P_2O_5/ha) and two levels of potassium (0,25 Kg. K_2O/ha). The experiment was initiated in 1964 and was repeated in 1965 on a new site. The crop was sown on Aug 4, 1965, after differential manuring according to plan. The treatment effects are given in Table 6.

Table 6 : **Yield of dry fodder of MP Chari in q/ha.**

	p_0	p_1	k_0	k_1	Mean
n_0	19.6	15 9	21.4	14.1	17.8
n_1	22 5	27.8	25.6	24.7	25.2
n_2	28.8	31.2	30.0	30.0	30.0
Mean ($\pm$1.32)	23.6	24.9	25.7	22.9	....

C D at 5% level for N = 4.72

n_0, n_1, n_2 represent 0,25,50 Kg. N/ha respectively.

p_0, p_1 represent 0,25 Kg. P_2O_5/ha respectively.

k_0, k_1 represent 0,25 Kg. K_2O/ha respectively.

There was a significant response to application of nitrogen as in the previous year. The response increased with increase in the level of nitrogen. Applications of P and K were without any effect.

Project 3 : **Studies on the comparative performance of various graminaceous fodder crops.**

(R. K. Pandey and S. P. Marwaha)

The experiment was started in 1964 and was repeated during the year. Maize yellow 2 from the Indian Agricultural Research Institute was replaced by Sudax (a cross between Sudan grass and grain sorghum) during the year. The crop was sown on 3-8-1965 The general yield level was low because of the late sowing and sub-normal rainfall.

Yield (dry weight) Kg./ha

Sl. No.	Varieties	Yield (±334)
1	M. P. Chari	2144
2	Jowar T 4	1100
3	Jowar 8 B	2357
4	Sudan grass	124
5	Sudax	3250
6	Maize T 41	330
	C. D. at 5% level 1003 2/ha	at 1% 1387.4/ha

The differences in fodder production among the graminaceous crops were significant. 'Sudax' gave the maximum yield which was about 52 per cent higher than that of MP *Chari*, the recommended variety in U. P., and *Jowar* 8 B was next best in performance.

Project 4 : **Varietal trials on cowpeas.**

(R. K. Pandey and S. P. Marwaha)

In addition to the seven varieties which were included in the trial in the previous year, three more varieties obtained from F. A. O., were added in the trial during the year (Table 8).

Table 8 : **Yield (dry matter) in Kg./ha.**

Sl. No.	Varieties	Source	Yield (±140·6)
1	Russian Giant	U. P.	862
2	Lobia Type 2	U. P.	650
3	E. C. 4211	I. A. R. I.	864
4	E. C. 4216	I. A. R. I.	822
5	E. C. 2790	I. A. R. I.	852
6	K. 397	I. A. R. I.	932
7	Cowpea Durgapura	Rajasthan	1128
8	F. A. O. 14·025	F. A. O	534
9	F. A. O. 14·023	F. A. O.	850
10	F. A. O. 14·021	F. A. O.	540

The varietal differences were not significant. However, it was indicated that variety No. 9 Durgapura (Rajasthan) gave the higher yield than Russian Giant Cowpeas recommended in U. P. This variety No. 9 had also shown the best performance in the previous year.

Project 5 : **Spacing and seed rate on MP Chari**

(S. P. Marwaha and R. K. Pandey).

This experiment was started with a view to finding out the optimum seed rate and spacing for obtaining maximum yield of fodder. The experiment comprised of four seed rates (2.5, 5, 7.5, 10 0 Kg./ha) and three inter-row spacings (22, 33, 44 cm) in addition to sowing by broadcast.

The experiment was laid out in split-plot design, with spacing as main plot and seed rate as sub-plot treatments in four replications. The crop was sown on July 29, 65. The effects of seed rates and spacing on the yield of M. P. Chari are given in Table 9.

Table 9 : **Yield of MP Chari (dry matter) in Kg./ha.**

Seed rate	INTER-ROW SPACING				
	Broadcast	22 cms.	33 cms.	44 cms.	Mean ±183.6
2.5 Kg. Seed/ha	2946	2946	1444	2128	2406
5.0 Kg. Seed/ha	2936	3160	2736	3116	2987
7.5 Kg. Seed/ha	3424	4522	3251	2972	3542
10.0 Kg. Seed/ha	4475	3325	3376	4250	3983
Mean (±227.4)	3486	3488	2826	3118	....

CD at 5% = 528.7 (for seed rate comparisons)
at 1% = 711.9 (for seed rate comparisons)

There was a progressive increase in yield with increasing seed rate. The increases followed a linear trend indicating that optimum seed rate for fodder production is higher than 10 Kg./ha. Seed rate remaining the same, close spacing gave slightly better production than wider spacing.

DIVISION OF PLANT IMPROVEMENT

A collection of 23 grasses and 118 legumes was maintained in the Plant Introduction garden. *Phaseolus atropurpureus* showed excellent growth and has been selected for introduction in grassland.

Apart from the above mentioned studies, the following experiments were initiated during the year:

1. Animal performance studies on *Heteropogon* grasslands.
2. Relative responsiveness of Hybrid Napiers to nitrogen manuring and their comparative performance.
3. Effect of foliar sprays with nitrogen and phosphorus on berseem seed production.
4. Weed control with herbicides in oats and wheat crops.

Researches contemplated:

The item of research envisaged to be started are given below, together with the object of study in each cases:

Grassland Management:

1. **Effect of spray fertilization on the quality and production of forage in Iseilema grasslands:**

   Object: To improve the nutritive value of hay through spray application of nitrogenous and phosphatic fertilizers.

2. **Seed production studies in grasses:**

   Object: To study the effect of nitrogen and phosphate on the seed yield of *Cenchrus ciliaris* and *C. setigerus*.

Soil Science and Fodder Agronomy :

1. **Effect of spray fertilization on forage and seed production of berseem :**

   Object : To assess if fertilizer dose applied through soil could with advantage be partly replaced by foliar application.

2. **Effect of varying levels of N, P and K on fodder and seed production of cowpeas and graminaceous Kharif fodders :**

   Object : To study the main effects and interactions of the three macronutrients on the yield of fodder and seed.

Weed Ecology and Control :

1. **The effect of 2, 4, 5-T alone and in combination with 2, 4-D on the control of woody perennial weeds of grasslands :**

   Object : To evolve a quick, effective and economical method of eradicating unwanted trees and bushes in natural grasslands.

   Control of nut grass :

   Object : To study the effect of MCPA and 2,4,5–T on the control of nut grass and their residual effect on the yield of wheat.

   Studies on mixed cropping of fodders :

   Object : 1. To improve the production of the first cutting of berseem by mixed sowing of berseem with *sarson* and oats.

   2. To extend the period of fodder supply by mixed sowing of lucerne and inter-copping of Hybrid Napier in berseem.

3. Papers published :

A paper entitled 'The Ecological Studies on the grasslands of Jhansi (U. P.)' by K. A. Shankarnarayan, S. P. Marwaha, R. K. Pandey and P. M. Dabadghao is ready for publication.

4. Extension :

(a) The Institute is in early stages of development and it is too early to issue results of practical value for immediate application.

(b) Among the results likely to be useful to the farmers, but needing further trial, mention may be made of (1) use of nitrogenous and phosphatic fertilizers for increasing the production of natural grasslands. (2) Mixed sowing of wheat and vetch for improving the nutritive value of the by-product. (3) Superior performance of 'Sudax' amongst the graminaceous fodders and cowpea No. 9 (Durgapura) as compared with other cowpea varieties.

(c) As the Institute is still in formative stages, no publicity activities have been initiated so far.

5. Conferences and Symposia :

No conference or symposium was organised by the Institute during the year under report.

6. Summary of Report :

Established in November, 1962, the Indian Grassland and Fodder Research Institute, completed its third working season during the year under report. Dr. Mukhtar Singh joined the Institute as Director on November 11, 1965. There was no other addition to the nucleus research staff.

The Institute is planned to be organised into five technical Divisions, each to be placed under a Head of the Division, to carry out multi-disciplined research on all aspects of the

production and utilisation of fodders and grasses. A proposal for the rapid organization and development of the Institute was also drawn up during the year.

The main research activities during the year related to grassland survey and management, and fodder agronomy. The importance of fertilizer use was brought out convincingly on lowlying grassland under *machuri* grass *(Iseilema laxum)* inspite of low rainfall received during the year. Application of 200 Kg. sulphate of ammonia and 125 Kg. superphosphate (single) increased the yield of dry grass from 38·32 to 58·95 q/ha. In the case of upland spear grass or *lumpa (Heteropogon contortus)* the fertilizer response during the year was less pronounced, probably because of the limiting moisture supply resulting from deficient rainfall.

Pot culture studies showed that all the three grasses namely, *sain (Sehima nervosum), dhawalu (Chrysopogon fulvus)* and *lumpa (Heteropogon contortus),* responded well to moister supply, but the former two seemed to require moister conditions than the latter.

The variations in the root system of five grasses suggested their relative adaptability and suitability for agricultural use. The deep rooting habit of *sain (Sehima nervosum)* and *lumpa (Heteropogon contortus)* conferred on them drought-resisting ability. The profusion of roots in *marvel (D. annulatum)* made it good soil-structure improver. The dense net-work of fine roots of machuri *(Iseilema laxum)* gave it soil-binding ability. The shallow rooting system of *dhawalu (Chrysopogon fulvus)* indicated their adaptability to shallow and rocky locations.

As the natural grasslands in India have generally no legume component, studies were initiated to explore the possibility of introducing a suitable legume by over-seeding with *bankulthi (Atylosia scarabaeoides).*

Grass and tree vegetation of the Institute farm was identified and different communities were mapped out in relation to the edaphic factors.

Field experiment on fodder crops revealed possibilities of introducing field vetches in wheat to improve the nutritive value of the by-product. Promising performance of 'sudax' (a hybrid between Sudan grass and Sorghum) and cowpeas 9 from Durgapura was indicated in comparative trials. Application of 250 Kg. sulphate of ammonia per hectare increased the yield of MP Chari by about 72 per cent.

7. Personnel:

Dr. Mukhtar Singh joined the Institute as Director on 11-11-1965. The following staff was in position at the end of the year 1965-66:

1.	Director	1	1600-1800
2.	Head of Division (Grassland Management)	1	1100-1400
3.	Ecologist	1	700-1250
4.	Farm Superintendent	1	350-900
5.	Research Assistants	2	210-425
6.	Junior Scientific Assistant	1	110-200
7.	Draftsman	1	150-240
8.	Head Clerk	1	210-380
9.	Accountant	1	130-300
10.	Steno-typist	1	110-180 + 20/- S. P.
11.	L. D. C.	1	110-180
12.	Driver	2	110-139
13	Peon	2	70-85
14.	Chowkidar	2	70-85
15.	Mali	2	70 85

Table 1 **Grass communities in relation to edaphic factors**
at Central Research Farm, (Year 1965)

Sl. No.	Name of community	Area in ha.	SOIL Depth*	SOIL Texture	Topography**	Remarks
1	*Sehima nervosum— Heteropogon contortus*	163.0	*Bharari Series* Shallow to moderately deep	Sandy loam to loam	Gentle slope	Well drained soil
2	*Heteropogon contortus*	17.6	*Bharari Series* Shallow	Sandy loam	Gentle slope with severe erosion	Eroded slopes and plains with impoverished soil and low moisture content
3	*Heteropogon contortus— Themeda quadrivalvis*	20.0	*Bharari Series* Shallow to moderately deep	Sandy loam	Gentle slope with severe erosion	Uplands and slopes having thin coarse soil with underlying loose parent rock
4	*Heteropogon contortus— Desmostachya bipinnata*	6.9	*Bharari Series* Shallow to moderately deep	Sandy loam	Gentle to moderate slope	Slightly alkaline soil

S. No.	Name of community	Area in ha.	SOIL Depth*	Texture	Topography**	Remarks
5	*Heteropogon contortus — Chloris virgata*	5.7	*Bharari Series* moderately deep	Loam	Gentle slope	Over grazed uplands
6	*Bothriochloa pertusa*	37.9	*Bharari Series* Shallow to moderately deep	Sandy loam	Gentle moderate slope	Uplands and lowlands under intense to moderate grazing
7	*Bothriochloa pertusa— Heteropogon contortus*	25 0	*Bharari Series* Shallow to moderately deep	Sandy loam to loam	Very gentle to Gentle slope	Uplands and lowlands under intense to moderate grazing
8	*Themeda quadrivalvis*	6.8	*Bharari Series* Shallow to moderately deep	Sandy loam	Very gentle to Gentle slope	Low-lying wet lands
9	*Chysopogon fulvus*	2.0	Rock out crop with practically no soil except in crevices of rocks	Gravelly	Hillock slope	Rocky habitats
10	*Iseilema laxum*	61.6	*Karari and Bharari Series* Deep soil	Sandy loam to loam	Moderate slope	Conditions of excess water on land subject to innundation

S. No.	Name of community	Area in ha.	SOIL Depth*	Texture	Topography**	Remarks
11	*Iseilema laxum— Dichanthium annulatum*	14.2	*Karari and Bhojla Series*	Sandy loam to clay loam	Plain	Moist and wet conditions
12	*Saccharum spontaneum*	13 2	*Pahuj Series* deep to very deep	Loamy	Moderate to stoop slope	Conditions of excess water along the river and natural drains, and flowing water
13	*Vetiveria zizanioides*	35.0	*Bhojla Series* Very deep soil	Clay loam	Moderate slope	Innundated conditions
14	*Vetiveria zizanioides— Eragrostis nutans*	1.4	*Bhojla Series* Very deep soil	Clay loam	Moderate slope	Innundated conditions
15	*Cotx lacryma jobi*	0.2	*Bhojla Series* Deep Soil	Clay loam	Gentle moderate slope	Natural drains and ditches

*Very shallow = 0-3″
Moderately deep = 9-18″
Deep = 18-36″
Very deep = Above 36″

**Very gentle slope = 1-3%
Gentle slope = 3-5%
Moderate slope = 5-10%
Steep slope = Over 10%