R. P. F. III

FINAL REPORT

1. Institute Code No: Phy IX (231)

2. I. C. A. R. Code No: PI-76/21-ICI-F 60/0311

3. Name and Address of Research Institute/Centre: Central Plantation Crops Research Institute, Regional Station Kayamkulam, Krishnapuram-690 533, Kerala, India.

4. Project Title: Distribution, absorption and translocation pattern of radioactive P and Rb in healthy and root (wilt) affected coconut palms.

5. Name and Designation of Project Leader

R.Snehi Dwivedi, Scientist S-2 (Physiology).

6. Name (s) and Designation(s) of Project Associates including Project Leader and work to be done:

Sl. No.	Name and Designation	Time spent	work done
1.	R.Snehi Dwivedi, Scientist S-2	15 man months	The items of work shown in the technical programme (Ttem II) have been carried out jointly by the three scientists.
2.	P.K.Ray, Scientist S-1	30 "	
3.	Sunny Ninan, Research fellow	15 "	

7. Location of Research Project with complete address (Division/Section/Sub-Centre)

C.P.C.R.I., Regional Station, Kayamkulam, Krishnapuram - 690 533, Kerala.

8. Date of start

1976

9. Date of termination

1981

10. (a) Objectives (Not more than 150 words)

The survey conducted on the nutrient status of coconut revealed that there is accumulation of N, P and K nutrients in the leaves of root (wilt) affected coconut gardens as compared to healthy ones. On the other hand the concentration of certain micronutrients like Zinc, molybdenum and Irom, has been found to drop below their critical limit in diseased palms. These findings indicated nutrient disorder and ionic imbalance in diseased palms. Since the disease caused retardation of growth and reduced the yield of the tree it was presumed that there might be certain imbalance in the absorption and translocation of nutrients and also in the distribution of photosynthetes and other methods. It was also thought that the incorporation of inorganic nutrients into organic complexed might be hindred in diseased palms. To understand these phenomens in greater depths and with more accuracy than with conventional methods, studies using tracer techniques were initiated.

(b) Practical Utility including background information (Not more than 150 words)

By employing radioisotopic technique on diseased crop it was thought possible to obtain some conclusive, authentic and quick information that could be utilised for predicting measures either to control or rehabilitate the existing diseased plantations, by balancing nutritional needs.

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

KASARAGOD-670 124, KERALA

RPF III

Project No. Phy, IX (231)

Date of Start: 1976

11. Technical Programme:

1. Application of radioactive materials $KH_2{}^{32}PO_4$ and ^{86}RbCl through soil, root, leaf axil and stem to coconut palms.
2. Seasonal variation in the absorption, translocation and distribution of ^{32}P and ^{86}Rb in root (wilt) diseased and healthy palms.
3. Determination of active root zone of diseased and healthy palms for efficient absorption of nutrients.
4. The absorption pattern of frond, leaf discs and excised roots of healthy and root (wilt) diseased palms.
5. Incorporation/utilization of ^{32}P and 86 Rb in different fractions of phosphorous and Potassium in healthy and diseased palms.
6. Tracing the site of accumulation and path of flow of nutrients in diseased and healthy palms by autoradiographic techniques.

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CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD-670 124, KERALA

RPF III
Project No. Phy. II (231)
Date of Start: 1976

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1. Absorption and distribution of ^{32}P in apparently healthy and root (wilt) affected coconut palms.

A. Field experiment:

Radioactive $KH_2{}^{32}PO_4$ was fed to Coconut palms by soil placement method.

In this method 5 mci $KH_2{}^{32}PO_4$ diluted to 3.2 litres of water (containing 40 ppm P) was applied to healthy and root (wilt) diseased palms through holes made at different depths of 10,30, 50 and 70 cms in the soil. In each hole 100 ml of radio active solution was injected and subsequently the soil was irrigated. Plant samples were collected from spindle, first fully opened, middle and outer leaves, stem and root after 1, 3, 5, 7, 9, 15 and 30 days of the treatment. After 7 days of treatment the activity was detected in both the categories of palms, but no marked difference was noticed between healthy and diseased palms with regard to the accumulation of ^{32}P. On 9th day the activity in the diseased palms was found to be higher than apparently healthy palms. The activity thereafter increased in diseased palms and remained higher than healthy through out the experimental period (Table 1).

B. Laboratory experiment:

Radioactive $KH_2{}^{32}PO_4$ was fed to excised leaves through the basal cut end of midrib. Tissues from the leaf lets were collected after 1, 5, 15, 30 minutes and 1, 3, 6, 9, 24 and 48 hrs. of treatment and examined for the radioactivity. Faster rate of absorption was recorded in healthy leaves in the initial stages, but later the difference in the absorption rate was not marked between healthy and diseased leaves (Table II)

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2. Organic incorporation of ^{32}P in diseased and healthy palms.

Leaves collected from experimental palms treated with radio active P were analysed for total radio activity. The incorporation of activity in Trichloracetic acid, Ethanol, Perchloric acid and Methanol extractable P was recorded. Besides this, total phosphorus and organic phosphorus (Sum of TCA, PCA, Methanol and Ethanol P) were also determined. It was interesting to note that although the accumulation of ^{32}P/g. dry matter was more in diseased palms, its incorporation into organic phosphorus was only 63.9 whereas the same was 82.2% in healthy palms. This was further confirmed by native P analysis where corresponding values were 90.4 and 64.6% respectively (Table 3).

3. Efficiency of different methods of nutrients application in Coconut:

Two methods viz. plant injection and soil placement techniques were tried. $H_2{}^{32}PO_4$ was used in this study which was simultaneously confirmed by tagged single super phosphate fertilizer application.

a) Plant injection technique:

^{32}P was fed to the palms through growing root tip, cut end of root, stem and leaf axil. In each method 1 mci $H_2{}^{32}PO_4$ contained in 1 litre complete nutrient solution was applied during summer and rainy seasons. After the treatment representative samples from spindle, middle and outer leaves were taken after 1, 3, 6, 9, 12, 18, and 24 hrs. and 3, 15, and 30 days for counting the radioactivity. The efficiency of different methods was judged on the basis of accumulation of ^{32}P (cpm/g dry matter) in the palm per unit time till 30 days, when equal

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amount of radio activity was applied.

Among the plant injection methods, the application of ^{32}P through cut end of root was most efficient. The radioactivity was detected in the palm after 4 hrs. of application. On the other hand radioactivity in the palms was detected after 9, 12, and 18 hrs. of application through stem, leaf axil and growing root tip respectively (Table 4). During summer the absorption of radioactivity was quick and the activity could be detected after 3, 6, 9 and 12 hrs. of application though cut end of root, stem, leaf axil and growing root tip respectively.

b) Soil placement method:

The radioactivity was applied to the palms through different soil placement methods viz. basin, circular trenche, stripe and holes made around the trunk. 5 mci $H_2{}^{32}PO_4$ diluted to 3.2 litre containing 40 ppm was applied to each palm. After the application of radioactivity in the soil, plant samples from spindle, middle and outer leaves and roots were collected at intervals of 1, 3, 5, 7, 9, 11, 15 and 30 days, and examined for the activity.

Out of the four methods tried in soil application, the placement of radioactivity through holes gave quick recovery but conve. dry matter was less than that of trench method through out the experimental period. ^{32}P was detected in the palm after 7 and 9 days of application in hole and trench methods respectively. Application through basin was least efficient and the activity could be detected only after 11 days of application (Table 5). In all the methods the activity in the palm during summer was detected about two days prior to that of rainy season.

3. Tracing of active root zone.

A study was conducted to trace the active root zone of

Coconut, based on maximum recovery of radioactivity applied to the root zone. Two isotopes viz. ^{32}P and ^{36}Cl were used for this study. It was revealed that the active root zone of coconut is confined to 0.5 to 1.2 m lateral distance from the bole and to a slanting depth of 20 to 30 cm reaching up to the top surface of the roots. Placement of fertilizers to this zone has been approved as recommendation to farmers.

5. Nutrient absorption under irrigation.

Irrigation practices to be adopted for coconut and the amount of water to be applied at each time, of irrigation were tested using $K_2{}^{32}PO_4$ in aqueous solution and ^{36}Cl in KCl solution. Effective and economical utilisation of nutrients were observed where the palms were irrigated once in 8 days with 225 litres of water. Similar effects were observed in case of seedlings when they were irrigated with 30 litres of water only at an interval of 3 days.

6. Efficiency of different phosphatic fertilizers in coconut.

Four phosphatic fertilizers viz. single sugar phosphate, rock phosphate, nitrophosphate and ammonium phosphate labelled with ^{32}P were applied to coconut in sandy loam soil. Each phosphate was found to be superior to other phosphatic sources of fertilizers for coconut in this type of soil. This finding has been approved as recommendation to farmers.

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Table 1. Absorption and the distribution pattern of ^{32}p and elemental P in different parts of healthy and root (wilt) diseased coconut palm.

Palm Parts	Condition of palm	^{32}p activity (CPM/g dry wt)								Phosphorus (%)
		Sampling data (days) after treatment								
		1	3	5	7	9	12	15	30	
Spindle	Healthy	nil	nil	nil	270	292	302	200	80	0.168
	Diseased	"	"	"	278	560	412	139	91	0.199
First fully opened leaf	Healthy	"	"	"	212	255	212	110	100	0.167
	Diseased	"	"	"	230	520	402	200	126	0.190
Middle leaf	Healthy	"	"	"	290	501	255	130	90	0.172
	Diseased	"	"	"	310	820	370	250	121	0.185
Outer leaf	Healthy	"	"	"	300	460	312	125	86	0.157
	Diseased	"	"	"	315	610	469	178	112	0.167
Stem	Healthy	"	"	"	60	112	75	50	21	0.146
	Diseased	"	"	"	76	120	96	60	35	0.122
Root	Healthy	"	"	"	65	76	59	36	12	0.047
	Diseased	"	"	"	62	67	52	30	18	0.043

Table 2. Absorption and accumulation of ^{32}p in the leaves similar in weight and area of diseased and apparently healthy palms under laboratory conditions.

Condition of palms	^{32}p activity cpm/100 mg dry wt.									
	Treatment duration									
	MINUTES				HOURS					
	1	5	15	30	1	3	6	9	24	48
Diseased	0	0	0	120	220	360	786	1580	2268	2013
Apparently Healthy	0	0	0	260	620	840	1020	1660	2276	2046

C.D. 76.15 (Significant at 0.1% level)

Table 3. Incorporation of ^{32}p (cpm/g dry matter) and elemental P (ug/g dry matter in different fractions of phosphorus.

Condition of palm	Total ^{32}p activity	^{32}p activity in total organic fraction	Different fractions of organic phosphorus (^{32}p incorporated)			
			TCA - P	PCA - P	M - P	E - P
Apparently healthy	2080	1710 (82.2)	740 (35.7)	260 (12.5)	570 (27.4)	140 (6.7)
Diseased	2880	1840 (63.9)	1040 (36.1)	150 (5.2)	520 (18.1)	130 (4.5)

	Total P	Total organic P	Different fractions of organic phosphorus (elemental P incorporated)			
			TCA - P	PCA - P	M - P	E - P
Apparently healthy	1600	970 (60.6)	300 (18.8)	200 (9.4)	360 (22.3)	110 (6.3)
Diseased	2000	1000 (50.0)	400 (20.0)	105 (7.5)	375 (18.8)	120 (6.0)

C.D. for percent incorporation - 3.8 (Significant at 1% level)

Values in parenthesis indicate percent incorporation of total ^{32}p and elemental P into phosphorus and its different fractions.

Table-4. Efficiency of different methods of plant injection for ^{32}P absorption and accumulation in coconut palm (Rainy Seasons)

Table 4. ^{32}P activity (CPM/g dry matter) after different period of sampling.

Palm parts	Hours 2	4	6	8	12	18	24	Days 3	15	30
						Growing root tip injection				
Spindle	nil	nil	nil	nil	nil	90	460	760	310	101
Middle leaf	"	"	"	"	"	180	592	1022	620	206
Outer leaf	"	"	"	"	"	160	521	980	340	112
Root	"	"	"	"	"	80	300	601	260	96
						Stem injection				
Spindle	"	"	"	117	240	311	507	620	306	210
Middle leaf	"	"	"	160	320	502	617	928	617	313
Outer leaf	"	"	"	200	612	610	612	860	532	211
Root	"	"	"	160	210	312	416	710	480	121
						Cut-root end injection				
Spindle	"	122	802	1220	1410	1501	1680	860	716	304
Middle leaf	"	330	460	580	660	991	1240	937	432	285
Outer leaf	"	196	227	390	416	711	1040	632	516	325
Root	"	126	192	216	312	501	674	411	302	205
						Leaf axil injection				
Spindle	nil	nil	nil	nil	320	512	635	872	285	170
Middle leaf	"	"	"	"	952	502	786	1034	600	301
Outer leaf	"	"	"	"	160	306	528	398	260	110
Root	"	"	"	"	140	312	360	230	220	98

Table-5

Efficiency of different methods of soil placement for ^{32}P absorption and accumulation in coconut palm (Rainy Seasons)

Table 5

Palm parts	^{32}P activity (CPM/g dry matter) after different period(days) of sampling								
	1	3	5	7	8	9	11	15	30
Hole method									
Spindle	Nil	nil	nil	240	282	315	382	301	201
Middle leaf	"	"	"	200	310	460	530	406	304
Outer leaf	"	"	"	160	200	320	301	250	185
Root	"	"	"	120	160	200	250	300	110
Strip method									
Spindle	Nil	nil	nil	nil	240	320	401	410	215
Middle leaf	"	"	"	"	425	570	610	592	300
Outer leaf	"	"	"	"	376	422	510	501	260
Root	"	"	"	"	120	180	280	310	180
Trench method									
Spindle	Nil	nil	nil	nil	280	350	480	510	295
Middle leaf	"	"	"	"	600	810	880	940	704
Outer leaf	"	"	"	"	402	521	610	606	364
Root	"	"	"	"	240	280	325	360	210
Basin method									
Spindle	Nil	nil	nil	nil	nil	nil	88	108	46
Middle leaf	"	"	"	"	"	"	81	100	50
Outer leaf	"	"	"	"	"	"	56	72	37
Root	"	"	"	"	"	"	34	64	30

13. Approximate expenditure incurred in the Project: (Give reasons for variation, if any, from original estimated cost)

14. Publications and material (one copy each to be supplied with this proforma)

a) Research papers 3

b) Popular articles 1

c) Reports -

d) Seminars and workshops (Relevant to the Project) in which the Scientists have participated:

1. Dr. P.K.Ray participated in the international Symposiumon the use of isotopes and radiations in research on soil and Plant relationships held at colombo, Sri Lanka - Dec. 11-15-1978.

e) Material developed such as new varieties of crops or breeds of farm animals, implements, products, etc.)

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15. Details (Nos. etc.) of Field/Laboratory Note books and final material and their location.

Relevent records, and field/Laboratory note books one kept in the plant physiology section, C.P.C.R.I., Regional Station, Kayamkulam.

16. Comments/suggestions of Project leader regarding possible future line of work that may be taken up arising of this project:

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17. Signatures with name of Project Leader and Associates:

R.S.Dwivedi
P.K.Ray and
Sunny Ninan

all the three workers have left the Institute.

Report prepared by Chacko Mathew, S-1
C.P.C.R.I., (R.S.) Kayamkulam.

18. Signature (with comments, if any) of Head of Division/Section/Station :

19. Signature (with comments, if any) of Director :