

GROWTH AND DEVELOPMENT OF CASSAVA UNDER THE TRADITIONAL AND THE MUKIBAT SYSTEMS OF PLANTING

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ABSTRACT

Two methods of propagating cassava were compared using 4 levels of fertilizer application. One method was the Mukibat system based on the grafting of *Manihot glaziovii* with *M. esculenta*. The other method was the Traditional or the ungrafted system using the stalks of the *M. esculenta* as planting material. Higher rates of NPK application resulted in a significant increase in plant height, leaf area index (LAI), root diameter, root length and root weight of cassava for both methods of planting. However, cassava plants under the Mukibat system had taller stature, larger root diameter and heavier root weight compared to those planted using the traditional system, although the latter had higher LAI.

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KEY WORDS: Cassava, *Manihot esculenta*, *Manihot glaziovii*. Mukibat and traditional systems of planting. Leaf area index. Root bulking.

INTRODUCTION

Among the factors needed to obtain optimum production of cassava (*Manihot esculenta* Crantz) are proper methods of propagation and use of cultural management practices such as fertilizer application. One method of propagation, the Mukibat system, has been adopted by farmers because of its advantages over the conventional method. The Mukibat system is based on the grafting of *Manihot glaziovii* with *M.*

esculenta. *M. glaziovii* is used as the scion because of its supposedly greater leaf area compared to other species of *Manihot*.

Fertilizer application is another factor necessary to increase tuber yield of cassava. Cassava needs nitrogen, phosphorus, and potassium for its vegetative growth, early root development, and for the translocation of starch from the leaves to the roots, respectively (Molinyawe, 1968). Nitis and Sumatra (1976) stated that fertilizer

application is essential since cassava plants exhaust the soil rapidly. When cassava has been planted for several seasons, the soil is depleted of nutrients and becomes highly unproductive unless heavily fertilized. Hadi and Gonzalie (1975) recommend application of NPK fertilizer to obtain high yield of Mukibat cassava. The amount of fertilizer needed, however, depends on soil type and climatic conditions.

MATERIALS AND METHODS

Preparation of Planting Materials. —

Mukibat grafts were prepared by splice grafting. A 15-cm long *Manihot glaziovii* scion was grafted to a 25-cm long *M. esculenta* stock (CV. Golden Yellow), each stem having almost the same diameter. A thin piece of coconut midrib was inserted in the pith of both scion and stock to strengthen the union of the graft. Masking tape was used as the binding material. The grafts were pre-germinated in the nursery for 10-15 days. Healthy sprouted grafts were selected from the nursery before transplanting them in the field. Mukibat plants are grafted cassava following the Mukibat system while traditionally-planted cassava are ungrafted plants, cuttings measuring 25-30 cm long of which were prepared from the mature stalks of *M. esculenta*.

Field Layout and Experimental Design. — An upland field with an area of 720 sq m was prepared and laid out at the last harrowing in a

split-plot randomized complete block design with 3 replications. Each subplot measuring 4 x 5 m was separated from the others by 1.0 m alleyway. The two systems of preparing planting materials (Mukibat and Traditional) served as the mainplots, while the fertilizer levels as the subplots. The treatments were designated as follows:

Systems of planting (mainplot)

- M₁ - Traditional system (using *Manihot esculenta*)
- M₂ - Mukibat system (using grafted *M. glaziovii*/*M. esculenta*)

Fertilizer levels (subplots)

- F₀ - control (no fertilizer application)
- F₁ - 30-60-90
- F₂ - 60-60-90
- F₃ - 90-60-90

Planting. — Mukibat grafts at 10-15 days old were transplanted while cassava cuttings were planted in a vertical position on ridges at a distance of 75 cm between hills and 100 cm between rows. Both cuttings (Traditional and Mukibat) were planted at the same time.

Cultural Management. — All the P and K fertilizers were applied at planting time, while N was applied in split: 1/3 of the total amount at planting and 2/3 at 3 months later. The fertilizers were applied before planting in the furrow and the last portion of N fertilizer was buried into the soil a few cm away from the stems of the plants. Replanting of

missing hills was done 2 weeks after planting, followed by hilling-up 6 weeks later using an animal-drawn moldboard plow. Periodic spraying of Thiodan and Benlate was done to protect the plants from insect pests and diseases, respectively.

RESULTS AND DISCUSSION

General Stand of the Crop.

Roots emerged from the traditionally-planted cassava 8-10 days after planting in the field, while Mukibat plants had already resumed their growth as they recovered from the shock of transplanting.

Variations were noted in the physical appearance of the plants

under the two systems starting at one month until the end of the study. Mukibat plants had more or less rapid rate of foliar cover development and were taller than traditionally-planted cassava.

Average Monthly Plant Height.

Statistical analysis revealed a significant difference in the height of plants under the two systems starting at one month after planting and thereafter (Table 1 and Fig. 1). Mukibat plants were consistently and significantly taller than traditionally-planted cassava during their entire growth duration of 4 months.

Application of higher levels of N (60 and 90 kg/ha) exerted a highly

Table 1. Effect of planting method and fertilizer level on shoot characters of cassava 4 months after planting.

Method	Fertilizer level	Plant ht. (cm)	Stem diameter (cm)	No. of Leaves	No. of branches	Leaf area index
Traditional	00-00-00	71.73	3.28	57.39	1.95	2.63
	30-60-90	95.90	3.30	86.94	2.39	3.99
	460-60-90	112.28	3.77	112.78	2.65	5.17
	90-60-90	120.54	3.69	109.17	2.61	5.00
Mean		100.11	3.51	87.07	2.40	4.19
Mukibat	00-00-00	111.15	3.09	69.85	1.899	2.37
	30-60-90	115.11	3.34	77.56	2.33	2.63
	60-60-90	134.69	3.38	116.50	2.50	3.95
	90-60-90	143.51	3.57	107.8	2.28	3.65
Mean		126.12	3.34	92.92	2.25	3.15
Grand Mean		113.11	3.43	92.25	2.32	3.67
C.V. (a) Planting (%) method		4.43	33.66	9.54	7.89	9.55
C.V. (b) Fertilizer (%) level		6.89	5.99	6.65	13.50	6.52

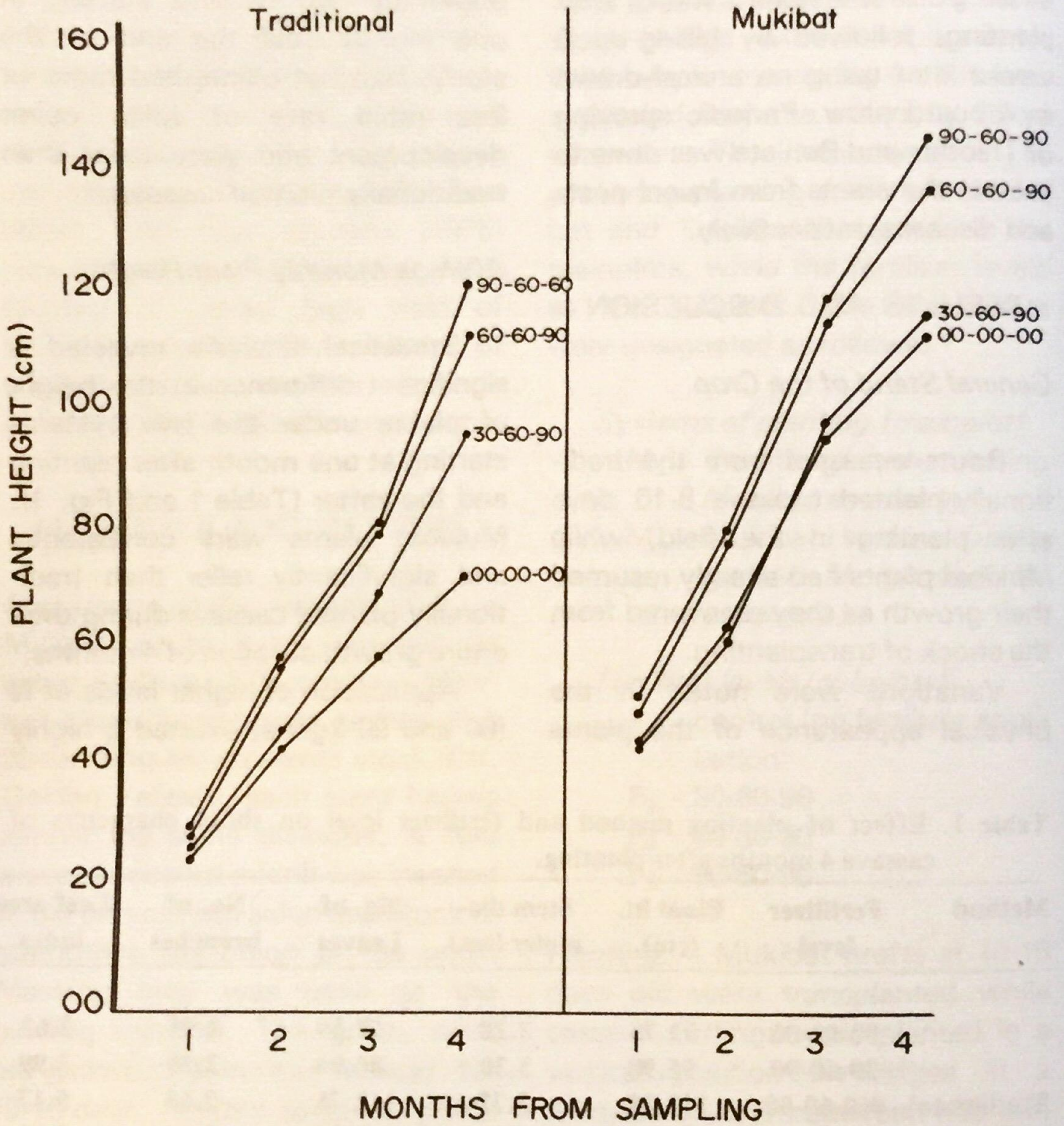


Fig. 1. Monthly plant height of cassava as affected by planting method and fertilizer level.

significant influence on plant height in all measurements from the first to the fourth month (Fig. 1). Plant height generally increased with increasing rates of N application in both systems of planting.

Average Monthly Stem Diameter.

Planting methods did not significantly affect the development of the

stem diameter. However, stem size increased from the first to the fourth month after planting in both systems and the relative difference in size gain between planting systems was maintained.

Higher levels of N application (60 and 90 kg/ha) caused a significant increase in stem diameter from the second to the fourth month. The peak of stem development was

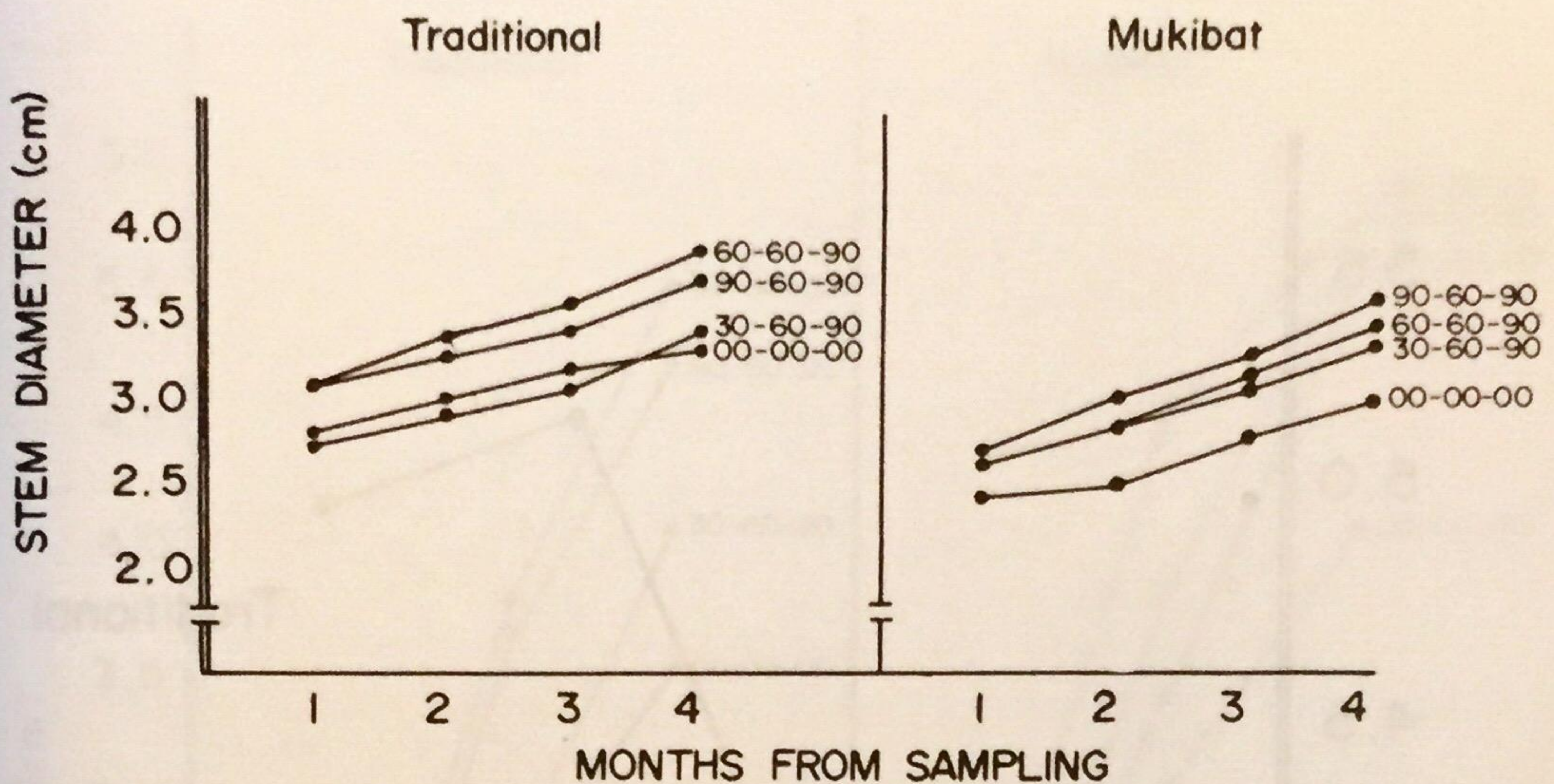


Fig. 2. Monthly stem diameter of cassava as affected by planting method and fertilizer level.

observed in the fourth month among plants supplied with N at the rate of 90 kg/ha. However, this parameter did not vary significantly between plants which received N at 60 kg/ha and 90 kg/ha which was evident during the second month up to the fourth month (Fig. 2). This result suggests that application of N at 60 kg/ha is enough for optimum stem development of cassava.

Average Number of Leaves per Plant.

Analysis of variance indicated no significant effect of planting method on the number of leaves produced per plant although application of N from 0-60 kg/ha markedly affected leaf production. In both systems of planting, plants that received N up to 60 kg/ha developed more leaves but this started to decline as the amount of N was increased to 90 kg/ha (Table 1). Perhaps, mutual shading among plants occurred thus

affecting their growth and development as shown by the reduced leaf formation and levelling off of leaf area index (LAI). This suggests that application of N at 60 kg/ha is the optimum requirement for maximum leaf production in cassava.

Average Number of Branches per Plant.

Planting methods did not significantly affect production of branches. However, N application significantly affected branch production in treated plots compared to the control plots (Table 1). The number of branches per plant increased as the amount of N application was increased, although no significant difference was observed among the treated plants. This result indicates that application of N at 30-60-90 kg/ha is sufficient for cassava to produce optimum number of branches per plant regardless of planting method.

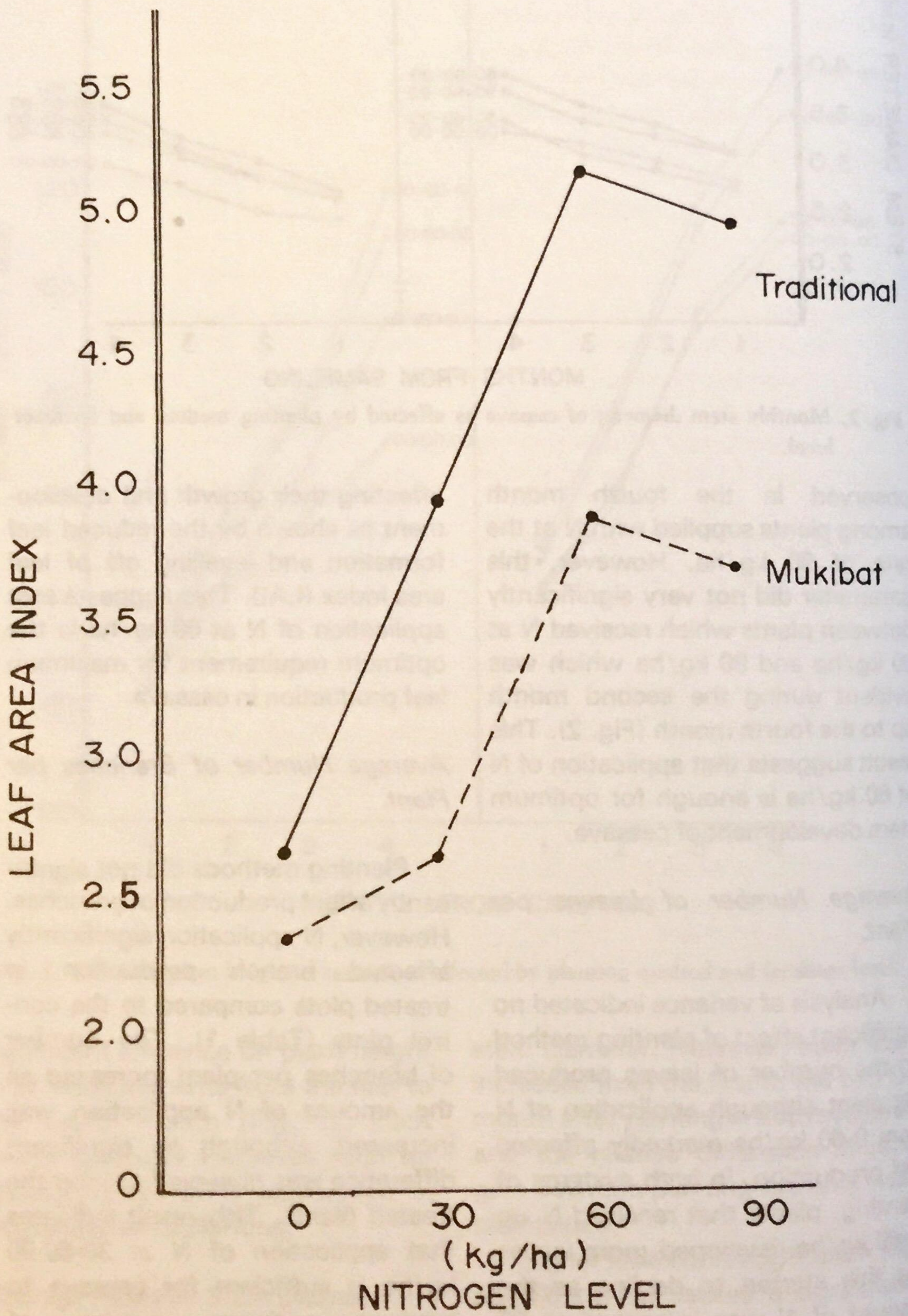


Fig. 3. Effect of systems of planting and rate of nitrogen application on leaf area index of cassava 4 months after.

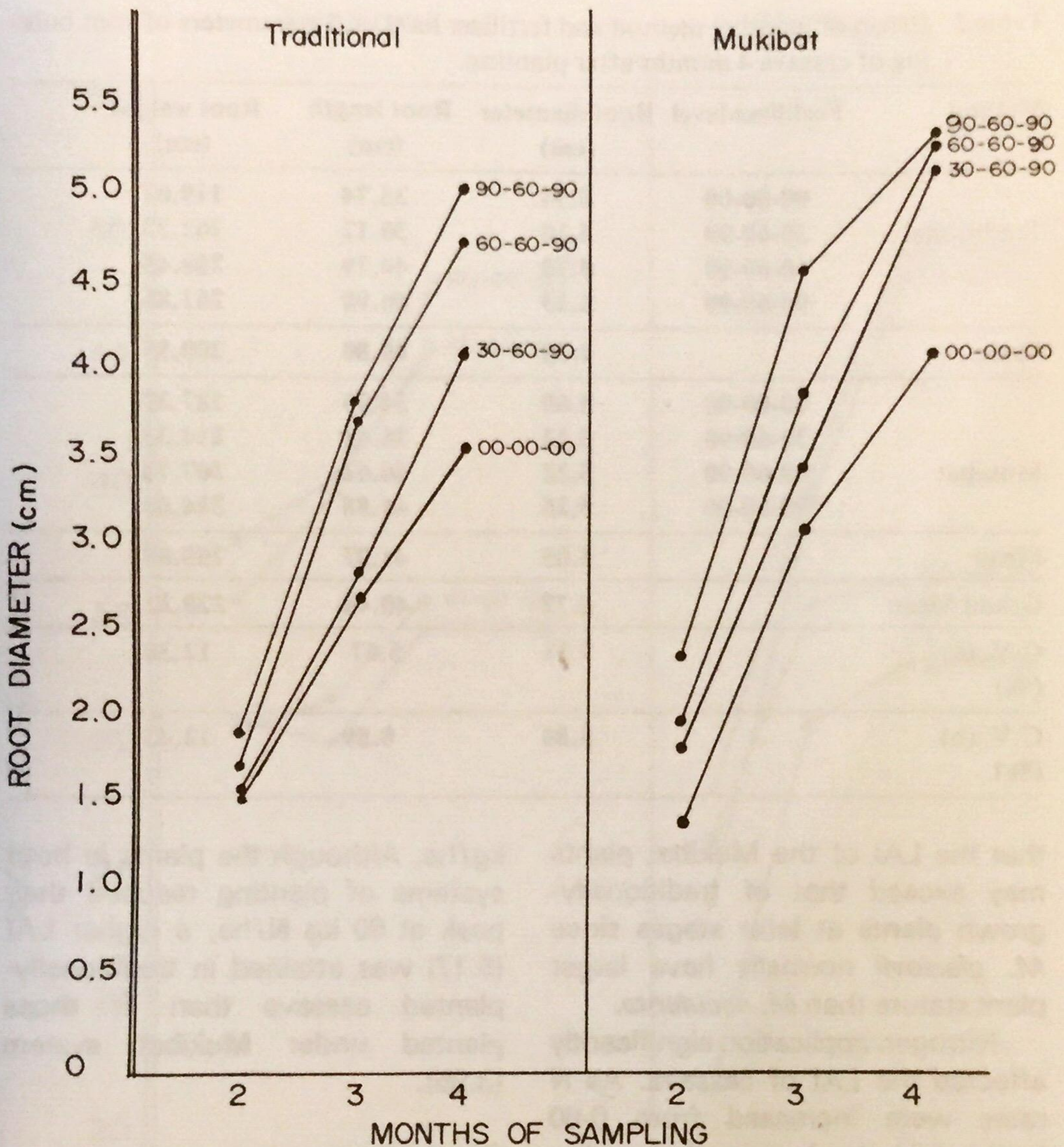


Fig. 4. Monthly root diameter of cassava as affected by planting methods and fertilizer levels.

Leaf Area Index (LAI).

Leaf area index (LAI) is a parameter that is a function of the crop growth rate (CGR). As leaf area increases, net assimilation rate (NAR) also increases resulting in increased CGR up to a certain level. Above this level, CGR may remain constant or may start to decline.

Traditionally-planted cassava

had significantly higher mean LAI (4.19) than those planted under the Mukibat system (3.15). This variation was probably brought about by the different varieties used as source of planting materials in the traditional system. Although more leaves were produced among Mukibat plants, individual leaves were smaller than those from traditionally-grown cassava. It may be expected, however,

Table 2. Effect of planting method and fertilizer level on 3 parameters of root bulking of cassava 4 months after planting.

Method	Fertilizer level	Root diameter (cm)	Root length (cm)	Root weight (cm)
Traditional	00-00-00	3.54	35.74	119.67
	30-60-90	4.10	36.12	162.22
	60-60-90	4.78	44.79	258.45
	90-60-90	5.13	46.90	261.86
Mean		4.38	40.80	200.55
Mukibat	00-00-00	4.60	34.25	187.39
	30-60-90	5.13	36.51	214.33
	60-60-90	5.22	46.62	307.78
	90-60-90	5.25	46.88	314.03
Mean		5.05	41.07	255.88
Grand Mean		4.72	40.48	228.22
C.V. (a) (%)		7.81	5.67	12.38
C.V. (b) (%)		5.88	8.59	12.43

that the LAI of the Mukibat plants may exceed that of traditionally-grown plants at later stages since *M. glaziovii* normally have larger plant stature than *M. esculenta*.

Nitrogen application significantly affected the LAI of cassava. As N rates were increased from 0-60 kg/ha, LAI also increased considerably. No significant difference was noted in LAI when N was applied at the rates of 60 and 90 kg/ha (Fig. 3).

A highly significant interaction between planting method and fertilizer level was observed. In traditionally-planted cassava, LAI had linear increase when the plants received N fertilizer ranging from 0-60 kg/ha. Only a slight increase in LAI was noted in the Mukibat plants when N was applied from 0-30

kg/ha. Although the plants in both systems of planting reached their peak at 60 kg N/ha, a higher LAI (5.17) was attained in traditionally-planted cassava than in those planted under Mukibat system (3.95).

Spatial Ground Cover.

Spatial ground cover is a parameter that gives an idea about canopy development which, in turn, determines the ability of the plant to spread and cover interspaces between plants. It is important in determining the proper and more efficient time of crop cultivation and weed control.

Mukibat plants had greater percentage of ground cover than traditionally-grown ones at N levels

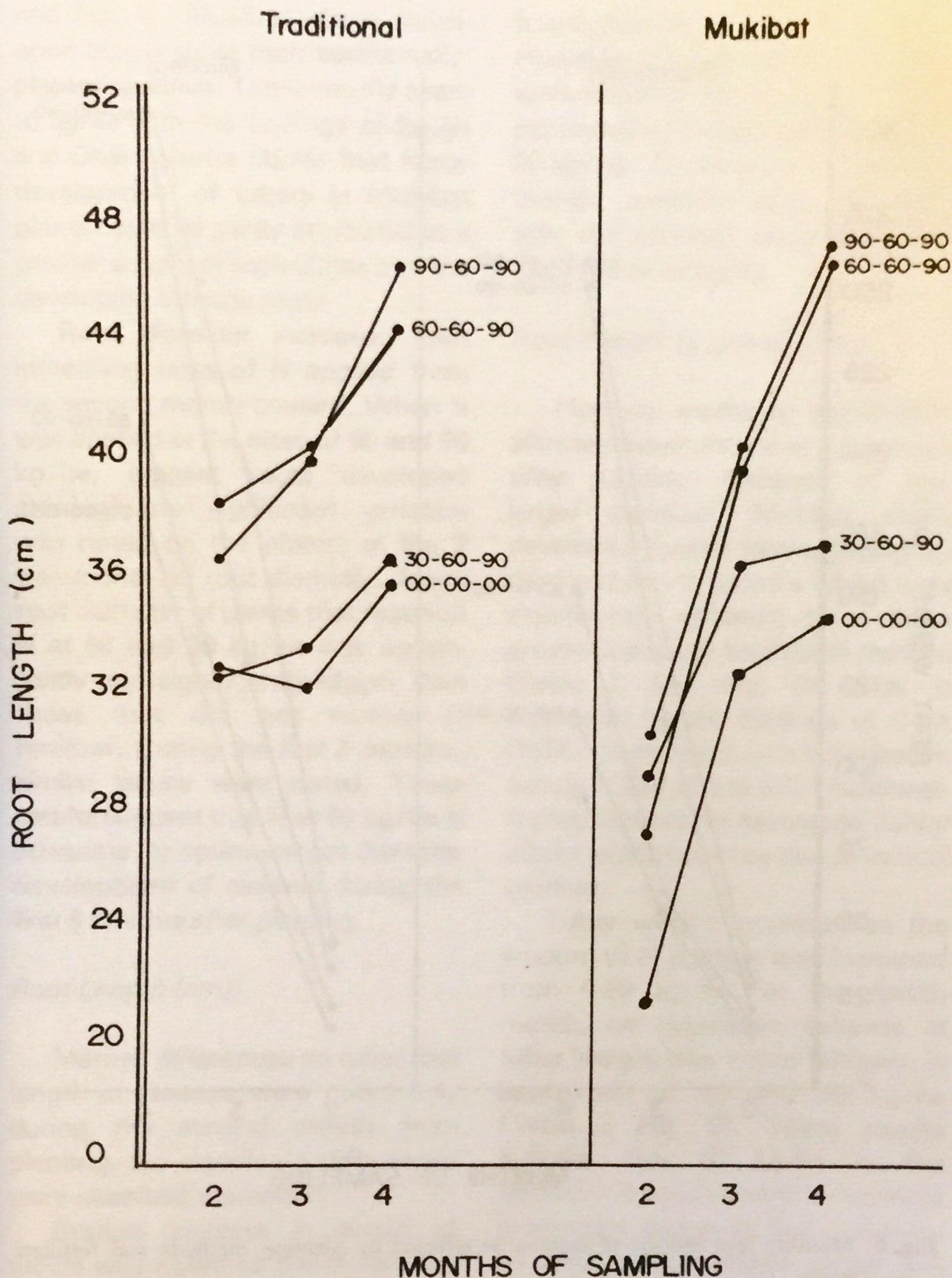


Fig. 5. Monthly root length of cassava as affected by planting methods and fertilizer levels.

of 0-60 kg/ha. However, the magnitude of increase in foliage development of the latter was greater than that of the former as shown by the

rapid increase in foliar cover as N level was increased from 0-60 kg/ha. In both systems of planting, application of N at 90 kg/ha enabled

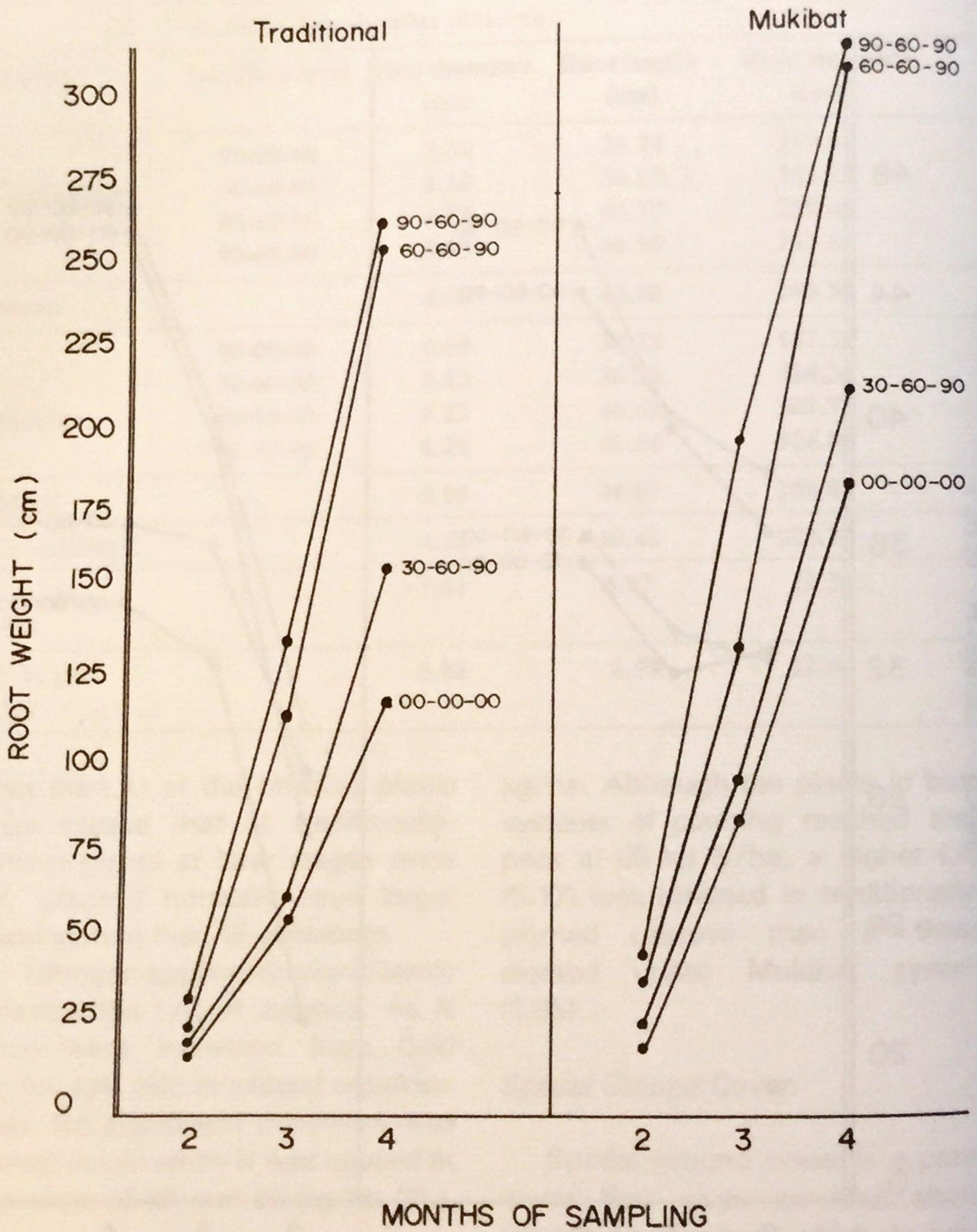


Fig. 6. Monthly root weight of cassava as affected by planting methods and fertilizer levels.

the attainment of 100% ground cover 4 months after planting.

Root Bulking

Root Diameter (cm).

In both systems of planting, initiation of root bulking started within 4-5 weeks after planting. Significant variations in root diameter were noted only during the third and fourth months (Table 2

and Fig. 4). Mukibat plants developed bigger roots than traditionally-planted cassava. These results seem to agree with the findings of Bruijn and Dharmaputra (1974) that faster development of tubers in Mukibat plants could be partly attributed to a greater supply of assimilates into the developing storage roots.

Root diameter increased with increasing rates of N applied from the second month onward. When N was applied at the rates of 60 and 90 kg/ha, biggest roots developed although no significant variation was noted on the effects of the 2 treatments on root diameter. Mean root diameter of plants that received N at 60 and 90 kg/ha was consistently and significantly bigger than those that did not receive N fertilizer. During the first 3 months, similar trends were noted. These results suggest that N at 60 kg/ha is adequate for optimum root diameter development of cassava during the first 4 months after planting.

Root Length (cm).

Marked differences on tuber root length of cassava were noted only during the second month from planting. No significant differences were observed thereafter.

Gradual increase in length of tubers was noted as the N fertilizer rates were increased from 0-90 kg/ha from the second up to the

fourth month (Table 2 and Fig. 5). However, no significant differences were noted as to the effects on this parameter of N application at 60 and 90 kg/ha. At the end of the fourth month, optimum length of tubers was not attained since the tubers were still developing.

Root Weight (g/plant).

Planting methods significantly affected tuber weight at 3-4 months after planting. Because of their larger diameter, Mukibat plants developed heavier tubers during the third and fourth months which were significantly different from those grown under the traditional method (Table 2 and Fig. 6). This is supported by the findings of Cock (1978) where maximum tuberization occurs at LAI of 3 to 3.5. Traditionally-planted cassava developed lighter tubers which could be due to mutual shading.

Tuber weight increased as the amount of N fertilizer was increased from 0-90 kg/ha. In the fourth month, no significant increase in tuber weight was noted between N application of 60 and 90 kg/ha (Table 2 Fig. 6). These results indicate that 60 kg/ha is the optimum N requirement for cassava production during its first 4 months of development either under the traditional or Mukibat system of planting.

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