The Agronomy of Mukibat Cassava

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SUMMARY

The Mukibat system of cassava production in Indonesia can lead to significant yield increases as compared to ordinary cassava. Preparation of graft combinations is time consuming, but once prepared, they can be reused for repeated planting. Mukibat cassava can be planted like ordinary cassava; digging planting holes, as often practices, can be omitted. For pure stand conditions, plant density of about 8,000 plants/ha was found to be optimal. Nitrogen fertilization increases yield significantly up to a level of 100 kg N/ha. No significant response to P and K was found. High root yield is obtained after a growth period of 12 to 15 months. Mukibat cassava has a somewhat higher HCN content than ordinary cassava.

Introduction

In Indonesia cassava has an important role as a staple food, particularly for low income groups. One possibility to increase cassava production in Indonesia is using the Mukibat system. This system was developed in 1952 by a farmer named Mukibat, and it is based on grafting or budding of a scion of *Manihot glaziovii* onto a stock of *M. esculenta*. Surveys indicated that the system leads to a considerably higher yield than conventional cassava cultivation (de Bruijn and Dharmaputra, 1974). Farmers consider the system as laborious while generally the taste of Mukibat cassava is slightly bitter due to presumably higher HCN content.

Realizing the high potential of the Mukibat system, research started in 1973 at the Faculty of Agriculture, Brawijaya University, with the support from the International Development Research Centre (IDRC), Ottawa, Canada. Additional support was by the Indonesian Institute of Sciences (LIPI) which acted as a counterpart for research projects funded by foreign countries. Results of the experiments have been reported periodically in the form of Progress Reports (I to X).

Planting material preparation

The preparation of planting material for Mukibat cassava cultivation entails more skill and time than that for conventional cassava cultivation. For large scale introduction of the Mukibat system, this poses a serious handicap. The results of our research, however, indicate that this impediment can be reduced. For this purpose, the grafts should be made in such a way that they can be reused several times. Planting material can be used repeatedly up to the fourth generation without significant yield reduction (Table 1). With respect to this, the stock section is lengthened by 5-10 cm.

Table 1. Influence of the reused grafts on the dry root yield (t/ha).

Grafting material	Experimental site (ecological type)			
	T. agung (dry)	Pagak (moderate)	Muneng (dry)	Lumajang (wet)
First original grafting	16.3	11.8	18.1	12.0
Second reused grafting	21.0	17.0	17.8	12.5
Third reused grafting	22.4	17.1	16.9	12.0
Fourth reused grafting	25.1	22.9	17.6	11.8

Progress Report VI, 1979.

Basically two methods have been developed to prepare planting materials for Mukibat cassava cultivation. These are the grafting and budding methods. Obviously the grafting method is easier to apply and it also leads to better results.

With this method one person can make about 200 graftings per day. To strengthen the connection section and to facilitate the grafting work, a thin piece of bamboo is put in the pith of both scion and stock and then bound with binding material such as plastic fibers.

Stock and scion material selection

All varieties in East Java ever tested could be used for the intended grafting. However, some varieties showed inconsistent response and high yielding varieties may not necessarily be high yielding when planted in the Mukibat system and vice versa. Some varieties considered to be most suitable for both Mukibat cassava cultivation as well as for conventional cassava cultivation are listed in Table 2. Faroka variety appears to be most suitable and better adapted to a wide range of environments.

For scion material, two types of M. glaziovii are available, the so called "black" and "white" types. Both are equally good, yet the black type may indeed be superior over the white type in a given environment. The scion material is usually taken from original M. glaziovii plants but material from Mukibat plants is also good (Table 3).

Planting method

In most cases farmers plant Mukibat cassava in large deep holes prepared some months prior to planting. The diameter varies from 0.5 to 1.5 m and depth from 0.1 to 1.0 m, depending on soil conditions and local customs. Experiments indicate, however, that Mukibat cassava can be planted in the usual way as ordinary cassava (Table 4) with land prepared by hoeing or plowing with or without making ridges.

Table 2. Varieties used for the Mukibat and ordinary cassava cultivation at three experimental sites.

System	Experimental site (ecological type)			
	Pagak (moderate)		Muneng (dry)	Lamajang (wet)
Ordinary	1. Faroka 2. Muneng 257 3. Soma	4. Ketan 5. Ngganing	1. Muara 2. Pandesi 3. 259-D-GM-42	1. Faroka 2. Muara
Mukibat	1. Faroka 2. Ngganing 3. Soma	4. Mentega 5. Ketan 6. Muneng 257	1. Pandesi 2. Faroka 3. Muara 4. Ngganing	1. Faroka 2. Ndoro 3. 257/B/Va 4. Ngganing 5. Valenca

Progress Report III, 1974/75.

Table 3. Influence of the origin of *M. glaziovii* material on the fresh root yield (t/ha).

Experimental site (climate)	Variety	Scion material origin: Original *M. glaziovii*	Scion material origin: Mukibat *M. glaziovii*
Pagak (moderate)	Faroka	34.7	37.4
	Ndoro	26.8	28.5
Muneng (dry)	Faroka	44.8	40.2
	Gading	38.5	42.7

Progress Report III, 1974/75.

Table 4. Effect of different land preparation on the fresh root yield (t/ha).

Land preparation	Var. at Pagak		Var. at Muneng	
	Faroka	Ndoro	Faroka	Gading
Like ordinary cassava*	25.6	25.0	43.8	34.6
Holes: 0.3 m deep	35.5	20.3	45.3	33.4
0.5 m deep	24.2	21.7	41.2	36.4

*Land is prepared for planting by hoeing evenly.
Progress Report III, 1974/75.

Plant density and spacing

Planting density is one of the most important factors to be considered to obtain high yields. Farmers of East Java may adopt a spacing of 1.5 to 3.0 m x 1.5 to 3.0 m, but the most common spacing is 2.0 x 2.0 m. However, Dharmaputra and de Bruijn (1976) suggested that the 2.0 x 2.0 m spacing is too wide to allow optimal yield.

Several spacing experiments have been conducted, but results varied considerably depending on the variety, on environment as well as on the quality of grafted planting material. Experiments with the high yielding Faroka variety indicated that the higher the plant density (up to 15,000 plants per hectare), the higher the root yield. On the other hand, it was found that yield increases over densities of 8,000 plants/ha were not significant. Based on this experience we consider a plant density of 8,000 plants/ha (spacing 1.25 x 1.00 m) being suitable.

Fertilizer application

The application of fertilizer in Mukibat cassava cultivation seems to be determined by the variety used, soil condition and soil nutrient levels in particular. In our research, mainly nitrogen fertilizer was considered, as nitrogen is also the only nutrient applied in conventional cassava cultivation in East Java. In several experiments no significant response of Pork fertilization occurred. This was probably due to the relatively good phosphate and potassium status of the soils at the experimental sites. Additionally Mukibat cassava responded less to application of organic matter, such as farm manure and organic wastes.

Optimum nitrogenous fertilizer application for Mukibat cassava in East Java was determined to be about 100 kg N/ha. The estimated result for the N optimum application using regression analysis lies between 75 and 145 kg N/ha (Progress Report IX, 1980). In other areas the situation is different and subject to further studies. An experiment in Lampung, South Sumatera, indicated a response to potassium and phosphate fertilizer in conventional cassava cultivation.

Time of harvest

Harvest time for cassava is commonly based on how the ontogenetic drift of dry matter accumulation into tuberous root sink against time, and another consideration is root yield quality.

In general farmers' practice, Mukibat cassava is harvested at 8 to 18 months old, depending on variety and particularly on local customs and the need for food. Our experiments indicated highest accumulation of dry matter in the root sink is reached at 12 to 15 months after planting (Dhapmaputra and de Bruijn, 1976). The same trend was found in other experiments.

Therefore, we suggest that harvest at 8 months is too early for good root yield. In the other hand, after about 15 months quality decreases as the roots begin to become woody and the taste deteriorates. Our tentative conclusion for the best harvest time is at 12 to 15 months after planting.

Cyanogenic glucosides

Cyanogenic glucocides usually expressed in HCN content, frequently pose a problem if cassava is used as food for human consumption or animal feed. For adults the lethal dosage is reported to vary between 50-60 mgs or 0.5-3.5 mgs/kg body weight.

Mukibat cassava has a relatively higher HCN content than conventional cassava. Experimental results show that HCN content of Mukibat cassava varied from about 50 to 200 mgs/kg fresh root depending on factors like fertilizer use, plant variety and plant density or spacing. Nitrogenous fertilization increased the HCN content, while phosphate and potassium applications tended to reduce HCN content. There is also an indication that the wider the spacing the higher the HCN content.

Conclusion

The Mukibat system of cassava cultivation is superior compared to the conventional cassava cultivation and most suitable for smallholders. Experiments showed that the disadvantages of the system, related to labour-input, could be minimized. A set of crop and soil management practices has been developed which is suitable for smallholders, permitting high yield and good quality.

For large scale cultivation in mechanized estates, the Mukibat system is less suitable. However, in transmigration areas with large numbers of smallholders concentrated and organized, the Mukibat system may be applied as well.

References

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