THE EFFECTS OF N-P-K FERTILIZER AND LEGUMES INTERCROPPING WITH CASSAVA IN DONG NAI PROVINCE

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Cassava (*Manihot esculenta* Crantz) is a fodder crop, starch crop for export, and the main food crop for more than 500 millions people in the world. In Vietnam, cassava has become an important food crop ranking the third after rice and maize. Cassava cultivation as a feedstock for ethanol production is now considered as an current issue and the opportunities to increase income for many farmers in recent times. Cassava, however, is often grown on poor soil types, farmers have not applied appropriate measures cultivation techniques and neither in fertilizer and other measure investment to improve soil nutrients making the depletion of soil fertility. Especially, farmer's cassava production techniques in remote areas are outdated leading to high production costs and economic efficiency.

The long-term experiments on the effect of NPK fertilizer levels and legumes intercropping with cassava have carried out at Hung Loc Agriculture Research Center since 1991. The purpose of the research is to determine the fertilizer formula and identify the crops that are suitable for intercropping to achieve high yield with highest economic efficiency.

Effects of NPK fertilizer formulations on cassava

Table 1**.** Effect of different NPK levels on fresh root and biomass yields, and starch content *(Dong Nai province, 2010 – 2011)*

Treaments	Fresh root yield (tons/ha)		Biomass yield (tons/ha)		Starch content (%)	
	KM60	SM937-26	KM60	SM937-26	KM60	SM937-26
1. 0N 0P 0K	5,50 n	8,10 m	2,02 l	2,89 l	17,75 l	21,00 ij
2. 0N 40P 80K	12,59 l	15,62 k	6,08 k	6,08 k	24,10 cd	25,55 ab
3. 40N 40P 80K	16,73 jk	18,78 fgh	10,71 dej	9,55 ghi	23,60 def	25,53 ab
4. 80N 40P 80K	18,23 ghi	21,99 cd	8,68 i	10,71 dej	21,83 hi	23,95 de
5. 160N 40P 80K	20,84 de	24,60 a	9,84 jgh	11,57 cd	21,20 ij	24,98 bc
6. 80N 0P 80K	13,31 l	19,24 fg	5,64 k	8,97 hi	221,63 hi	26,08 a
7. 80N 20P 80K	17,48 hij	7,89 ghij	9,26 hi	0,42 efg	22,43 gh	25,18 b
8. 80N 80P 80K	22,57 bc	21,02 a	1,68 c	2,15 c	20,73 j	23,23defg
9. 80N 40P 0K	4,92 n	4,92 n	2,89 l	2,46 l	18,00 l	19,75 k
10. 80N 40P 40K	13,31 l	18,52 fgh	5,79 k	7,23 j	20,32 jk	23,23 defg
11. 80N 40P 160K	17,07 ij	19,85 ef	11,28 cde	15,34 b	22,95 fg	26,13 a
12.160N 80P 160K	23,73 ab	24,16 a	15,81 b	18,23 a	22,08 efg	26,25 a
CV%	14,15		17,58		6,83	
$LSD_{0.05}$	2,36		1,83		0,37	

Based on the research results of NPK levels applied for cassava from 1991 to 2010 and 2011, both KM 60 and SM 937-26 cassava varietal experiments, the higher level of NPK obtained

the higher fresh root yield, biomass yield and starch content with significant difference compared to the control and lower NPK formulations (Table 1).

Table 2**.** Economic return of fresh root yield of two varieties KM60 and SM937-26 *(2010-2011)*

Treatments	Total income (vnd.000)		Total cost	Profit (vnd.000)	
	KM60	SM937-26	(vnd.000)	KM60	SM937-26
1. 0N 0P 0K	6 325	7 315	5 700	625	3 615
2. 0N 40P 80K	14 779	17 693	7 950	6 829	10 013
3. 40N 40P 80K	19 240	21 597	8 507	10 733	13 090
4. 80N 40P 80K	20 965	25 289	9 064	11 901	16 225
5. 160N 40P 80K	23 955	28 290	10 178	13 777	18 112
6. 80N 0P 80K	15 307	22 126	8 414	6 893	13 712
7. 80N 20P 80K	20 102	20 574	8 739	11 363	11 835
8. 80N 80P 80K	25 956	27 623	9714	16 242	17 909
9. 80N 40P 0K	5 658	5 658	7 469	-1 811	-1 811
10.80N 40P 40K	15 307	21 298	8 264	7 043	13 034
11.80N 40P 160K	19 631	22 828	10 664	8 967	12 164
12.160N 80P 160K	27 290	27 784	12 428	14 862	15 356

Effect of legumes intercropping with cassava

The study results of legume intercropping formula with cassava in 2010-2011 showed that Leucaena leucocephala, Casia javanica and groundnut intercropped with cassava with or without fertilizer gained the highest fresh root yield and economic efficiency (Table 3, 4).

Table 3**.** Effect of intercropping formulas to fresh root yield, biomass yield and starch content *(Dong Nai province, 2010 – 2011)*

Treatments	Fresh root yield (tons/ha)		Biomass yield (tons/ha)		Starch content (%)	
	Fertilizer	Without fertilizer	Fertilizer	Without fertilizer	Fertilizer	Without fertilizer
1. Cassava monoculture	20,00	10,16	7,50	6,88	23,90	19,98
2. Cassava + Pigeon pea	23,50	13,28	9,38	5,63	25,23	21,93
3. Cassava + Japanese knotweed	23,75	12,56	9,06	5,31	24,63	21,50
4. Cassava + Groundnut	25,63	15,47	10,16	5,78	24,95	23,30
5. Cassava + Vigna cylindrica	22,19	13,91	9,38	5,00	23,50	22,33
6. Cassava + Canavalia gladiata	24,06	14,69	9,06	6,88	25,45	22,75
7. Cassava + Leucaena leucocephala	29,41	21,53	17,22	11,80	26,95	24,18
8. Cassava + Casia javanica	27,78	20,42	17,78	12,64	25,65	23,05

Table 4. Economic return of fresh root yield in the legume intercropping formulas (2010 – 2011)

Treatments	Total income (vnd.000)		Total cost (vnd.000)		Profit (vnd.000)	
	Fertilizer	Without fertilizer	Fertilizer	Without fertilizer	Fertilizer	Without fertilizer
1. Cassava monoculture	30.600	15.539	11.352	7.980	19.248	7.559
2. cassava + pigeon pea	35.859	20.320	12.053	8.680	23.806	11.640
3. cassava + Japanese knotweed	36.337	19.220	12.053	8.680	24.284	10.540
4. cassava + groundnut	41.706	23.667	14.053	10.680	27.653	12.987
5. cassava + vigna cylindrica	36.946	21.276	13.153	9.780	23.793	11.496
6. cassava + canavalia gladiata	36.815	22.471	12.053	8.680	24.762	13.791
7. cassava + leucaena leucocephala	45.050	32.937	12.853	9.480	32.197	23.457
8. cassava + casia javanica	42.500	31.237	12.853	9.480	29.647	21.757

The experiments results of N P K fertilizer and legumes intercropping on cassava from 1991 to 2011 showed that:

- The fertilizer formula of NPK 80-40-80 and 80-80-80 obtained the highest fresh root yield with good economic efficiency.
- Intercropping legumes with cassava gained higher economic efficiency than that of cassava monoculture.
- Intercropping with peanut, cassava gave highest economic efficiency; the intercropping models had also provided a significant amount of fertilizer to cassava and improved soil fertility through organic matter returned.