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Performance of Rabbit Breeding Does Fed Concentrate and Lablab Combinations During Pregnancy and Lactation

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Abstract: Nulliparous crossbred does aged 10 months were used to investigate the effect of feeding varying levels of concentrate and lablab on performance of rabbit does. The does were allocated to four concentrate and lablab hay combinations on a gram:gram basis (weight supplied daily): 20:130 (CL1), 40:110 (CL2), 80:70 (CL3) and 100:50 (CL4). Does on CL2, CL3 and CL4 had 28% higher feed intake than those on CL1 during the premating phase. Feed intake in the first week of pregnancy, was 7% higher on CL3 than on CL2 and CL4 which had 10% higher intake than CL1. Feed intake was similar for all treatments in the second, third and fourth weeks of pregnancy and during lactation. Does gained weight in the first, second and third weeks of pregnancy for all the treatments. In the fourth week however, does on CL2, CL3 and CL4 lost weight. All the does lost weight during lactation. Feed conversion showed marked variation during pregnancy and lactation. Feed conversion was negative for all the treatments especially in the first and third weeks of lactation. Gestation length decreased with increase in concentrate level from CL1 to CL3. Litter size at birth, alive at birth and up to 14 days postpartum was similar for all treatments. Litter size at 21 days postpartum was 1.7-2.3 lower for CL4 than CL1, CL2 and CL3. Kit mortality on CL4 was significantly higher than the other treatments. Litter gain was significantly higher for CL2 at 7 days postpartum and CL1 at 21 days postpartum than the other treatments. Total kit gain was similar for all treatments. Treatment levels up to CL3 did not negatively affect reproductive performance of nulliparous does despite doe weight loss during lactation.

Key words: Breeding does, concentrate, lablab hay, performance, rabbit

INTRODUCTION

Litter size remains the most important biological variable to profitable animal production (Pope and First, 1985). Litter traits are considered a character of the doe because of the large environmental component of variance associated with the doe during kindling and raising a litter to weaning (Kalil *et al*., 1987). Availability of nutrients to the developing litter during the later half of pregnancy influences birth weight of the offspring therefore, maternal malnutrition compromises neonatal survival through its adverse effect on birth weight (Smith and Somade, 1994).

Early growth and embryo survival of rabbits are dependent in part on the intrinsic ability of the dam to provide an adequate maternal environment (Yahaya, 1993). The first three weeks of the rabbit's life, when it should feed on milk from the doe only, are very important and will affect its future growth, development and ability to thrive. The mammary glands start developing slowly in early pregnancy and rapidly in the last week of pregnancy, therefore, nutrition determines how steady milk production will be and when it will reach its peak production (Sandford, 1986).

In most developing countries such as Nigeria, cost of concentrate is very high and most backyard rabbit producers have to resort to feeding kitchen wastes and forages in combination or solely to their rabbits. The current high cost of commercial feeds, has necessitated the need for forages to play a prominent role in the nutrition of rabbits. This is especially so, because of the availability of forages and ability of rabbits to use forage protein for production. This high cost of feed has resulted in the search for cheaper and more cost effective ways of producing rabbits. Forages, especially legumes with their high protein content, have the potential of meeting this need for cheaper feed sources for rabbits. Harris *et al.* (1981) reported that does maintained their body weight

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Table 1: Nutrient composition (%DM) of concentrate and forage hay fed to does

	Dry matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Ash
Concentrate meal	94.11	22.84	13.44	12.11	43.65	7.96
Lablab	96.42	13.43	19.44	28.40	19.47	19.26

after three parities on 28, 54 and 74% lucerne diets. Though total litter weights were significantly ($p<0.05$) heavier for the 54 and 74% diets than the 24% diet, individual 56-day weights were not significantly different. When comparing the 54% lucerne with a commercial diet, Harris *et al*. (1981) reported significantly greater total 28-day litter weights on 54% lucerne diet than the commercial diet.

Lablab (*Lablab purpureus)*, is an annual leguminous plant. The plant is grown for food and feed for livestock. After harvesting the seed, the forage is used as feed for livestock. It has a crude protein content of 15.7%, crude fibre content of 31.3% and ash content of 10.3% (Henricksen and Minson, 1985). The nutrient composition of lablab compares well with that of alfalfa (Oyawoye *et al*., 1990). Ruiz and Lukefahr (1998) fed lablab at the rate of 0, 25 and 50% in combination with 100, 75 or 50% commercial pellet diet to growing rabbits and reported that partial replacement of commercial feed with fresh lablab forage, increased profit margins, despite their slow growth performance. There is however, a dearth of information on the use of lablab forage by breeding rabbits. This study was designed to investigate the effect of feeding varying levels of concentrate and lablab on performance of nulliparous does during pregnancy and lactation in the semi-humid environment.

MATERIALS AND METHODS

Study site: The experiment was conducted in the rabbitry of the National Animal Production Research Institute, Shika, Nigeria (10°11' N and 7°8' E, 650 m above sea level).

Animals and housing: Nulliparous crossbred rabbit does were used for this study. The rabbits were progenies obtained from mating between New Zealand White X California and California X Chinchilla breeds. The rabbits were individually housed in metal cages of dimensions 120×60×50 cm located in a well-ventilated house. The house is completely walled with wide, open windows covered with wire mesh and mosquito netting. The experimental animals were kept, maintained and treated in adherence to accepted standards for the humane treatment of animals.

Experimental procedure: Twenty-eight nulliparous does aged 10 months were randomly allocated to four concentrate and lablab treatment combinations in a completely randomized design. The treatments comprised concentrate and lablab hay combinations on a gram: gram basis of: (CL1) 20:130, (CL2) 40:110, (CL3) 80:70 and (CL4)100:50, of a 150g air-dry/day total feed supply. This comprises in percentage proportions of (1)13.3:86.7, (2) 26.7:73.3, (3) 53.3:46.7 and (4) 66.7:33.3, respectively.

Prior to the study, the does were fed a concentrate meal consisting 22% CP and 10.88MJ ME kg^{-1} which contained in percent proportions: maize 39.24, groundnut cake 42.26, maize offal 15.00, bone meal 3.0, salt 0.25 and vitamin/mineral premix 0.25. This diet formed the concentrate used in the study in combinations with lablab. Table 1 shows the proximate composition of the concentrate and lablab hay fed to the rabbits. Lablab (13% CP) was cut at harvest after seed production and air-dried in a room to retain its green colour and quality. The lablab was chopped before feeding. At 08.00 h the various levels of concentrate and lablab were weighed and offered separately in earthen feeders to the rabbits. Leftovers and wastage were weighed daily. Water was supplied *ad libitum* daily in clay waterers. During pregnancy and the first week of lactation, the various combinations were offered to does. However, the concentrate supply was increased to 150 g day^{-1} in the second week and 200 g^{-1} day in the third week of lactation for all the does.

At mating, does were mated to intact bucks. Pregnancy diagnosis was done by palpation on the fourteenth day and also by monitoring their weight change. Does found to be open were remated. Earthen nesting pots were supplied to each doe on the 25th day of pregnancy. Does were weighed at start of the study, mating, kindling and at weekly intervals during pregnancy and lactation. Kits were counted and weighed at kindling and subsequently at weekly intervals. Parameters monitored were feed intake, doe weight changes, litter size and weight. The study lasted twelve weeks.

Statistical analysis: Data collected were subjected to analysis of variance using the General Linear Model procedure. Pair-wise difference method (pdiff) was used to separate significant means (SAS, 1987).

RESULTS AND DISCUSSION

Crude protein intake was similar for CL1 and CL2 though significantly lower than CL3 and CL4 (Table 2). Crude fibre intake of rabbit does decreased with increase

Table 2: Nutrient intake of does offered levels of concentrate and lablab during pregnancy

Nutrient intake ($gDM\ d^{-1}$)	Concentrate: Lablab level (g:g)			
	CL1	CL2	CL3	CL4
	20:130	40:110	80:70	100:50
Crude protein	17.9±0.61[b]	18.9±0.61[b]	22.9±0.63[a]	21.9±0.61[a]
Ether extract	21.4±0.46[a]	20.3±0.46[b]	18.4±0.47[c]	16.6±0.46[d]
Crude fibre	29.9±0.56[a]	27.4±0.56[b]	22.2±0.58[c]	19.5±0.56[d]
Nitrogen free extract	26.6±0.96[b]	28.5±0.96[b]	35.4±0.99[a]	33.8±0.96[a]
Ash	20.3±0.35[a]	18.5±0.35[b]	14.9±0.37[c]	13.1±0.35[d]
Energy (kcal DE kg^{-1} DM)*	407.74	424.49	459.75	395.63

Means with different superscript along rows are significantly different at ($p<0.05$). *Calculated energy

Table 3: Weight change and total gain of nulliparous does fed concentrate and lablab combinations during pregnancy and lactation

Weight	Concentrate:lablab treatment (g:g)			
	CL1 (20:130)	CL2 (40:110)	CL3 (80:70)	CL4 (100:50)
Initial weight (kg)	2.34±0.11	2.30±0.11	2.34±0.11	2.36±0.11
Final weight (kg)	2.39±0.11	2.43±0.11	2.50±0.11	2.57±0.11
Mating weight (kg)	2.34±0.12	2.43±0.12	2.45±0.12	2.50±0.12
Kindling weight (kg)	2.38±0.14	2.43±0.14	2.58±0.14	2.57±0.14
Weight gain (g)	50.0±50.4	133.3±50.4	160.0±50.4	210.2±50.4

in level of concentrate offered to does. Energy intake however increased as level of concentrate intake increased up to CL3 and then decreased on CL4. Rabbits on CL4 were apparently not taking as much energy as the other treatments despite the fact that they were offered the highest level of concentrate. Weight of nulliparous does was not significantly ($p>0.05$) different at mating, kindling or at the end of the study (final weight) for all the treatments (Table 3). Treatment CL2, CL3 and CL4 had 80 to 160 g higher weight gain than CL1 at the end of the study.

Table 4 shows total feed (concentrate and lablab) intake of rabbit does during pregnancy and lactation. Does on CL2, CL3 and CL4 had similar feed intake, which was significantly ($p<0.05$) higher than for CL1 during the premating phase. Rabbits adjust their feed intake according to the balance of proteins, the energy concentration of the feed and other dietary components such as minerals and crude fibre (Lebas *et al.*, 1986). In the first week of pregnancy, does on CL3 had significantly ($p<0.05$) higher feed intake than does on CL1 and CL2, while does on CL2 and CL4 had similar feed intake which was significantly higher than for CL1. However, in the second, third and fourth weeks of pregnancy, feed intake was similar for all the treatments. This indicates the ability of does to adjust their feed intake, to meet their nutrient requirement within a wide range of concentrate and lablab levels. Feed intake in rabbits is correctly regulated between 2200-3200 kcal DE kg^{-1} of feed (Lebas *et al.*, 1986). There was however a slight drop in feed intake in the fourth week of pregnancy. Lebas *et al.* (1986) reported that feed intake progressively increases with pregnancy and drops off markedly just before kindling. During the lactation phase, all the treatments had similar feed intake. However, in the second and third weeks of lactation, CL1 does had significantly ($p<0.05$) higher feed intake than CL4 (2nd week) and CL3 and CL4 (3rd week). Voluntary intake of feed by rabbit does during pregnancy and especially during lactation is of major concern as does do not appear to eat enough to meet their requirement for lactation even when feed offered is adequate. Parigi Bini and Xiccato (1998) reported that voluntary feed intake, rather than milk production was the limiting factor on rabbit doe productivity.

Concentrate intake (Fig. 1) was significantly ($p<0.05$) lower for CL1 and CL2 compared with CL3 and CL4 during pregnancy and first week of lactation. CL3 and CL4 had similar concentrate intake even though the quantity supplied was different. This shows that does' concentrate intake during pregnancy was between 60 to 73 g^{-1} day even when 100 g^{-1} day of concentrate was offered. Concentrate intake was similar for all treatments and increased during lactation in the second and third weeks. This was because concentrate supply was increased to 150 and 200 g^{-1} day to increase nutrient intake of does for lactation.

Lablab intake of does (Fig. 2) increased to mid of pregnancy for all treatments, decreased after mid pregnancy and was stable during lactation. Lablab intake therefore increased during pregnancy for all the treatments and decreased during lactation. This reduction in lablab intake during lactation could be because of increase in concentrate supplied to does in the second and third weeks of lactation.

In the pre-mating phase, first, second and third weeks of pregnancy, does gained weight (Table 5) for all the treatments. Does on CL2, CL3 and CL4 had significantly higher gain in the premating phase and third week of pregnancy than CL1. Weight gain was similar for all treatments in the first and second weeks of pregnancy. This result indicates the ability of does to meet their requirements within the range of 20 to 100 g concentrate intake for gain during pregnancy. In the fourth week however, does on CL2, CL3 and CL4 lost weight while CL1 does had significantly ($p<0.05$) higher weight gain than CL3. The reason for this result is not clear for the reverse effect would be expected at this stage of pregnancy when fetal development is in top gear. During lactation, all does

Table 4: Total feed intake (grams/day) of breeding does fed different levels of concentrate and lablab during pregnancy and lactation

	Concentrate: Lablab treatment (g:g)			
Phase	CL1 (20:130)	CL2 (40:110)	CL3 (80:70)	CL4 (100:50)
Premating	64.54±4.76[b]	90.43±4.76[a]	90.29±4.76[a]	93.74±4.76[a]
Pregnancy:				
1st week	92.92±3.27[c]	102.7±3.27[b]	114.2±3.27[a]	105.7±3.27[b]
2nd week	116.0±4.58	122.1±4.58	123.5±4.58	110.8±4.58
3rd week	123.9±4.55	122.6±4.55	122.1±4.55	115.4±4.55
4th week	109.2±4.84	118.3±4.84	104.5± 4.84	105.0±4.84
Lactation:				
1st week	124.9±8.04	121.6±8.04	106.1±8.04	111.2±8.04
2nd week*	218.9±17.48[a]	201.7±17.48[ab]	197.0±17.48[ab]	164.8±17.48[b]
3rd week**	239.3±17.76[a]	206.3±17.76[ab]	185.1±17.76[b]	174.6±17.76[b]

Means with different superscripts along rows are significantly different ($p<0.05$). * 150g $^{-1}$day concentrate offered. ** 200g $^{-1}$day concentrate offered. Total feed intake= concentrate + lablab intake

Table 5: Weight gain (grams/day) of rabbit breeding does fed different levels of concentrate and lablab during pregnancy and lactation

	Concentrate: Lablab treatment (g:g)			
Phase	CL1(20:130)	CL2(40:110)	CL3(80:70)	CL4(100:50)
Premating	5.71±4.04[b]	18.57±4.04[a]	15.72±4.04[ab]	20.0±4.04[a]
Pregnancy:				
1st week	4.29±7.30	10.02±7.30	14.29±7.30	10.0±7.30
2nd week	22.86±9.12	1.43±9.12	0.00±9.12	1.43±9.12
3rd week	1.43±3.15[c]	12.86±3.15[ab]	18.57±3.15[a]	8.57±3.15[bc]
4th week	1.43±2.52[a]	-2.86±2.52[ab]	-8.57±2.52[b]	-4.29±2.52[ab]
Total gain (g)	200±45.89	233.3±45.89	175±45.89	125.0±45.89
Lactation:				
1st week	-12.86±6.25	-5.71±6.25	-8.57±6.25	-5.72±6.25
2nd week*	8.57±4.95[a]	-7.14±4.95[b]	-1.43±4.95[ab]	5.72±4.95[ab]
3rd week**	-2.86±4.57	-4.29±4.57	-10.0±4.57	-4.28±4.57
Total gain (g)	-116.7±63.8	-83.3±63.8	-125±0 63.8	-62.5±63.8

Means with different superscripts along rows are significantly different ($p<0.05$). *150 g^{-1} day concentrate offered. **200 g^{-1} day concentrate offered

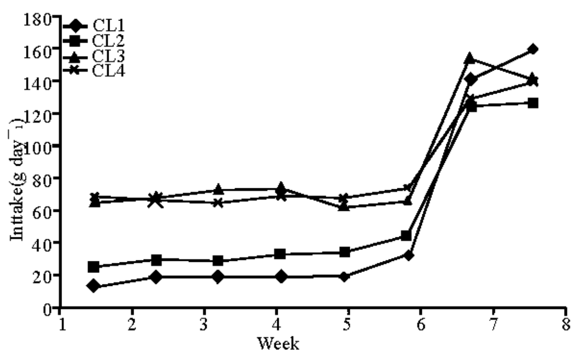

Fig. 1: Concentrate intake pattern of nulliparous does fed concentrate and lablab combinations during pregnancy and lactation. CL1=20:130, CL2=40:110, CL3=80:70 and CL4=100:50. Week 1= premating phase, Week 2-5= pregnancy phase and Week 6-8= lactation phase

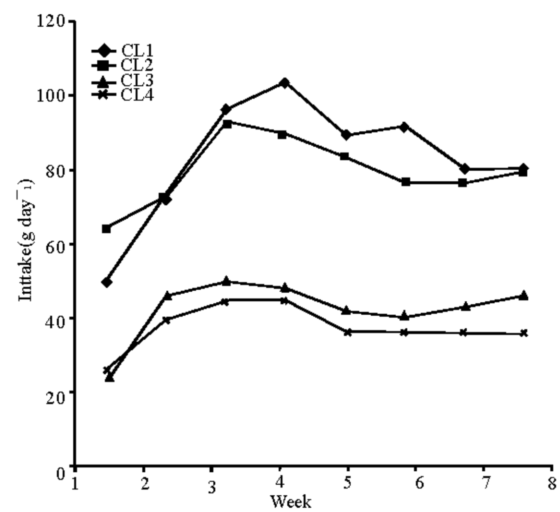

Fig. 2: Lablab intake pattern of nulliparous does fed concentrate and lablab combinations during pregnancy and lactation. CL1=20:130, CL2=40:110, CL3=80:70 and CL4=100:50. Week 1= premating phase, Week 2-5= pregnancy phase and Week 6-8= lactation phase

lost weight in the first and third weeks. In the second week of lactation, does on CL1 and CL4 gained weight while those on CL2 and CL3 lost weight. Doe weight gain on CL1 was significantly ($p<0.05$) higher than on CL2 though similar with CL3 and CL4. This indicates that the does were not meeting their nutrient requirement for lactation on the combinations given even when the concentrate level was increased to 200g and were therefore breaking down body reserves to meet their lactation requirement.

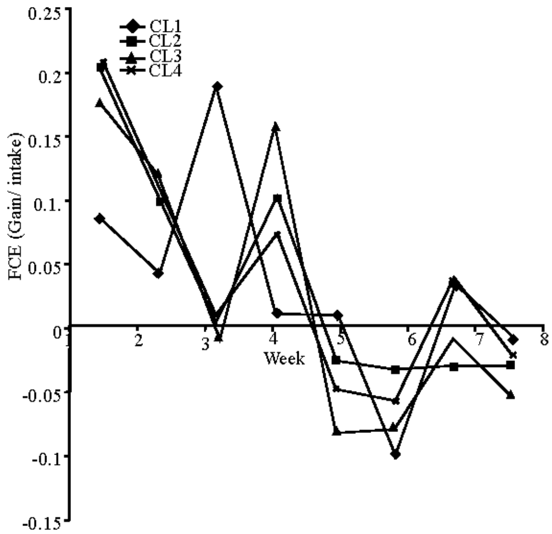

Fig. 3: Feed conversion efficiency of nulliparous does fedconcentrate and lablab combinations. CL1 = 20:130, CL2 = 40:110, CL3 = 40:110 and CL4 = 100:50. Week 1 = premating phase, Week 2-5 = pregnancy phase and Week 6-8 = lactation phase

Feed conversion efficiency of does (Fig. 3) showed marked variation during pregnancy and lactation for all the treatments. The trend however showed a decline in feed conversion efficiency with progression of pregnancy especially in the fourth week of pregnancy. During lactation, feed conversion efficiency was negative for all the treatments especially in the first and third weeks of lactation, indicating that the does were breaking down body tissue for milk production and hence losing weight. Rabbits require high-energy intake of 300 kcal DE kg^{-1} $W^{0.75}$ which, increases to 360 kcal DE kg^{-1} $W^{0.75}$ during maximum milk production (Lebas *et al*. 1986) between the 18th and 23rd day of lactation (Paufler, 1985; Sandford, 1986). This high nutrient requirement was likely not met at the levels of concentrate and lablab offered.

Gestation length (Table 6) decreased with increase in concentrate level from CL1 to CL3. CL1 and CL4 had similar gestation length while CL3 had the lowest gestation length. Litter size at birth, alive at birth and up to 14 days postpartum was similar for all the treatments. Litter size at 21 days postpartum was 1.7-2.3 ($p<0.05$) lower for CL4 than the other treatments. Number of kits

Table 6: Gestation length, litter size and kit mortality of nulliparous does fed concentrate and lablab combinations

	Concentrate: Lablab treatment (g:g)			
Parameter	CL1 (20:130)	CL2 (40:110)	CL3 (80:70)	CL4 (100:50)
Gestation length (days)	33.0±0.69[ab]	32.0±0.69[bc]	31.8±0.60[c]	34.0±0.60[a]
Litter size:				
At birth	5.3±0.72	5.0±0.72	6.0±0.62	4.8±0.62
Born alive	5.3±0.63	4.7±0.63	5.8±0.55	4.8±0.55
7-d postpartum	5.3±0.59	4.7±0.59	5.3±0.51	4.5±0.51
14-d postpartum	5.3±0.65	4.7±0.65	5.3±0.56	4.0±0.56
21-d postpartum	5.3±0.80[a]	4.7±0.80[ab]	5.3±0.69[a]	3.0±0.69[b]
Kit mortality:				
No. dead 7-d postpartum	0.00±0.23	0.00±0.23	0.50±0.20	0.25±0.20
No. dead 14-d postpartum	0.00±0.20	0.00±0.20	0.00±0.18	0.50±0.18
No. dead 21-d postpartum	0.00±0.29[b]	0.00±0.29[b]	0.00±0.25[b]	1.00±0.25[a]
No. dead 0-21 days	0.00±0.47[b]	0.00±0.47[b]	0.50±0.40[b]	1.75±0.40[a]
0-21 days (%)	0.00±0.82[b]	0.00±0.82[b]	6.25±0.37[b]	43.75±0.37[a]

Means with different superscripts along rows are significantly different ($p<0.05$)

Table 7: Litter weight and gain of does fed concentrate and lablab combinations

	Concentrate: Lablab treatment (g:g)			
Parameter	CL1 (20:130)	CL2 (40:110)	CL3 (80:70)	CL4 (100:50)
Weight (g):				
Litter birth weight	240.0±18.42	223.3±18.42	265.0±18.42	237.5±18.42
Kit birth weight	46.2±3.30	48.3±3.30	48.1±2.80	52.6±2.80
Litter weight at 7-d PP	608.3±47.84	650.0±47.84	637.5±47.84	525.0±47.84
Litter weight at 14-d PP	816.7±74.73[ab]	866.7±74.73[a]	837.5±74.73[ab]	637.5±74.73[b]
Litter weight at 21-d PP	1166.7±128.78[a]	1050.0±128.78[a]	1075.0±128.78[a]	600.0±128.78[b]
Weight gain:				
Litter gain at 7-d PP	368.3±35.69[ab]	426.7±35.69[a]	372.5±35.69[ab]	287.5±35.69[b]
Litter gain at 14-d PP	208.3±52.57	216.7±52.57	200.0±52.57	112.5±52.57
Litter gain at 21-d PP	350.0± 41.74[a]	183.3±41.74[b]	237.5±41.74[ab]	137.5±41.74[b]
Total litter weight gain	926.7±87.37[a]	826.7±87.37[a]	810.0±87.37[a]	537.5±87.37[b]
Total kit weight gain	180.7±14.61	183.6±14.61	154.2±14.61	135.4±14.61

Means with different superscripts along rows are significantly different ($p<0.05$). PP = postpartum dead was similar for all the treatments up to 14 days postpartum. Percent kit mortality was significantly ($p<0.05$) higher for CL4 than the other treatments. Though protein intake of rabbits on CL4 was adequate, energy intake was low resulting from lower feed intake of the rabbits. It is likely that these does were not producing enough milk to cater for their young hence the higher mortality in this group.

Litter birth weight (Table 7) and weight at 7 days postpartum were similar for all the treatments. At 14 and 21 days postpartum, litter weight was significantly ($p<0.05$) lower for does on treatment CL4 than CL2 but similar with CL1 and CL3. This result is similar to Harris *et al.* (1981), who reported total litter weights were significantly ($p<0.05$) heavier for the 54 and 74% lucerne diets than the 24% diet. Litter gain was significantly higher for does on CL2 at 7 days postpartum and CL1 at 21 days postpartum than the other treatments. Total litter gain decreased with increase in concentrate level and was significantly ($p<0.05$) lowest for CL4 compared with the other treatments. Total kit gain was similar for all the treatments though it decreased with increase in concentrate level. Harris *et al.* (1981) reported non-significant difference in individual 56-day weights of does fed 24, 54 and 74% lucerne diets.

CONCLUSION

This study shows that increasing the ratio of lablab: Concentrate at the levels fed to nulliparous does, increased litter size at 21 days postpartum, total litter gain and decreased kit mortality. Levels of concentrate and lablab up to CL3 (80:70) did not negatively affect reproductive performance of nulliparous does, despite weight loss during lactation.

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