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Cassava Leaf Silage and Cassava Peel as Dry Season Feed for West African Dwarf Sheep

By Anaeto, M., Sawyerr A.F., Alli, T.R., Tayo, G.O., Adeyeye, J.A.
& Olarinmoye, A.O.

Babcock University

Abstract - The study was undertaken to evaluate the effect of feeding cassava leaf silage (CLS) and cassava peels (CP) on performance characteristics and some haematological parameters of West African Dwarf (WAD) sheep. Nine sheep were randomly allotted into three treatments, with three sheep per treatment. The control diet (T1) consisted of grass, while sheep in (T2) and (T3) were fed with CLS and CP at 1.5% of their body weight, respectively for a period of seven weeks. The average daily weight gain, body length, withers height and heart girth were measured at weekly intervals. In addition, blood samples were collected at the beginning and end of the experiment and analyzed for PCV, WBC, Lymphocyte and Neutrophil count. Statistical analysis showed that animals fed with CP had a significant weight gain ($P < 0.05$), while there was no significant difference in wither height, body length and heart girth, respectively. However, there was a significant differences ($P < 0.05$) in the haematological parameters measured. No mortality was recorded during the experiment.

Keywords : cassava leaf silage, growth performance, haematology, WAD sheep.

GJSFR-D Classification : FOR Code: 110202, 070199



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Cassava Leaf Silage and Cassava Peel as Dry Season Feed for West African Dwarf Sheep

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Abstract - The study was undertaken to evaluate the effect of feeding cassava leaf silage (CLS) and cassava peels (CP) on performance characteristics and some haematological parameters of West African Dwarf (WAD) sheep. Nine sheep were randomly allotted into three treatments, with three sheep per treatment. The control diet (T1) consisted of grass, while sheep in (T2) and (T3) were fed with CLS and CP at 1.5% of their body weight, respectively for a period of seven weeks. The average daily weight gain, body length, withers height and heart girth were measured at weekly intervals. In addition, blood samples were collected at the beginning and end of the experiment and analyzed for PCV, WBC, Lymphocyte and Neutrophil count. Statistical analysis showed that animals fed with CP had a significant weight gain ($P < 0.05$), while there was no significant difference in wither height, body length and heart girth, respectively. However, there was a significant differences ($P < 0.05$) in the haematological parameters measured. No mortality was recorded during the experiment. It can be concluded that CLS and CP are good feed resources for maintaining sheep during the dry season.

Keywords : cassava leaf silage, growth performance, haematology, WAD sheep.

I. INTRODUCTION

Sheep are valuable domestic animals in the tropical livestock production system. Sheep in the tropics account for approximately 34% of the total population of the world grazing ruminants and represent a valuable resource in most developing world. (Njidda and Kibon, 2004). The lack of good nutritive feed during dry season is partly responsible for low productivity and reproduction. Thus, sheep can be sustained with cassava leaf silage and cassava peels during difficult months of the dry season.

Nigeria is currently the world's largest producer of cassava crop (IITA, 2005). Peasant farmers mostly grow cassava as a primary staple food but cassava is also being used as a cash crop to produce industrial ethanol, starches, tapioca, and livestock feeds. Ruminants can be fed not only on cassava tuber, but also the stem, leaves, peel and various by-products of tuber processing such as residues from starch, "garri" and "fufu".

Hydrogen cyanide (HCN) toxicity is considered to be a limiting factor in using high level of cassava leaves in the diets of monogastric animal. However,

ruminants can neutralize the harmful effects of HCN through the activities of rumen microbes and can therefore utilize cassava leaves more efficiently.

According to Limon, 1992; Kayouli & Lee (2000) silage making is an appropriate method to conserve cassava leaf as feed for use during dry season feeding.

The introduction of cassava leave silage to smallholder farmers in Indonesia was reported by Marjuki et al (2008), in Malawi IITA (2004) but the use of cassava leave as forage plant has not been popular in Nigeria.

Cassava peels form the bulk of residue from cassava root after post harvest and processing. It is a good source of energy in ruminant feeding systems, serving either as the main basal diet or as a supplement.

Many researchers have reported that dietary components have measurable effects on the blood hence blood constituents are widely used in nutritional evaluation and survey of human and animals. The general objective of this study was to evaluate the effect of cassava leaf silage and dried cassava peels on performance of WAD sheep and on some blood components.

II. MATERIALS AND METHODS

a) Experimental Location

The study was carried out at Babcock University Poultry and Livestock Farm located in Ilara-Remo of Ikenne local government area of Ogun state. This region is in the rainforest zone of Nigeria with an annual rainfall of about 1500 mm and mean temperature of 27°C. Ilara is in the south-west geopolitical zone of Nigeria and falls on latitude of 6°54'N of the equator and longitude 3°42'E of Greenwich.

b) Management of the Experimental Animals

Nine WAD sheep having an average body weight of between 8.67 and 9.33 kg were used for the seven weeks feeding trial. The sheep were tagged and allowed 14 days adjustment period before the onset of the study. All the animals were treated for external and internal parasite with ivermectin according to their body weight (1ml per 25kg). Oxtetracycline L.A. injection (200mg/ml) was administered as prophylaxis.

c) Experimental Diets and Method of Feeding

The cassava leaf silage was prepared by cutting about 30 cm of the cassava top. It was sun dried for 24

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hours and then chopped about 2-4cm, sprinkled with 5% molasses and sealed in polyethylene bags. Silage samples were taken after 30 days of ensiling and proximate analysis of cassava silage and cassava peel were carried out following the procedure of AOAC (1990). The cassava peels was bought from the market.

The sheep were assigned to three dietary treatments in a completely randomized design (CRD). Each treatment had three sheep that were allowed to graze freely during the day between 8:00am-12:00pm and 14:00pm-16:00pm and upon return, were fed with CLS (T2) or CP (T3) at 1.5% of their body weight while the control (T1) was not given supplement. All the sheep had access to clean drinking water. Weekly body measurements; weight gain, withers height, body length and heart girth were measured and recorded. Also, the physical characteristics such as colour, mould growth, smell and pH levels of cassava silage were evaluated.

d) Hematological Analysis

The animals were bled from the jugular vein at the beginning and end of the experiment and the blood samples were kept in bottles containing Ethylene Diamine Tetra Acetic acid (EDTA) and were sent to the laboratory for packed cell volume (PCV), white blood count (WBC), lymphocyte and neutrophil count.

e) Statistical Analysis

The data obtained were subjected to Analysis of Variance ANOVA using (SAS, 1997) and the significant difference between treatments means were separated using LSD test at 5% level of significance.

III. RESULTS AND DISCUSSION

The proximate analysis of the cassava leaf silage and cassava peel is presented in Table 1. The dry matter and crude protein values of the cassava leaf silage in this study are similar in values to (Marjuki et al. 2008), but the CP value is less than 24.7% reported by (Adegbola and Okonkwo, 2002). Devendra (1997), attributed the apparent lack of interest in the use of cassava leaves for feeding ruminants to inadequate appreciation of the relative high crude protein content of the leaves. The ether extract and crude fibre of the CLS were within the acceptable range (4.0-15.2 and 4.8-15.4) respectively but, the ash content was lower compared to (Smith, 1992). The dry matter and crude fibre of the CP were similar to those reported by (Adeloye et al. 2006).

The protein content was also within the range 2.8-6.5, however, the ether extract was higher and the ash content lower.

The silage pH value was acidic 4.36. Based on the greenish brown colour, absence of mould and a pleasant smell, the silage was considered to be of good quality.

Table 1 : Proximate analysis of cassava leaf silage and cassava peels

Constituent %	CLS	CP
Dry matter	30.39	29.2
Crude protein	15.46	5.72
Crude fibre	13.86	9.8
Ether extract	4.80	9.37
Ash	2.20	2.23

The effect of the feeding experiment on the performance of WAD sheep is shown in Table 2. The total weight gain of the sheep in T1, T2 and T3 were significantly different ($P < 0.05$) from each other. The sheep fed cassava peels (T3) gained more weight than T2 and T1. This finding agrees with Fomunyan and Meffeja (1987) who fed sheep on three levels of dried cassava peels and growth rate increased linearly with increasing dietary levels of cassava peels. Sheep on cassava leaf silage did better than the control. The result also agrees with Fernandez and Preston (1978), who reported an increase in daily weight gain for ruminants fed with cassava foliage. Feeding cassava leaf silage has been reported to increase body weight gain (Bunyeth & Preston, 2006; Yousuf et al 2007). The sheep grazed on grass alone suffered a weight loss due to scarcity of grass. Therefore, for optimum production, grazing animals should be given supplement such as CLS and CP during the dry season as rumen degradability of cassava leaves and cassava peels is high 84% and 83%. The body length, heart girth and wither height were not significantly different. Similar observations were reported by Ahmed (1977) who observed no effect on the body length and withers height of sheep fed dry cassava peel diets. There was no mortality recorded during the feeding experiment.

Supplementing cassava leaf silage and cassava peel did not affect the sheep as the animals were apparently healthy and grazing freely.

Table 2 : Performance of WAD sheep fed cassava leaf silage and cassava peels

Parameters	T1 (Control)	T2(CLS)	T3(CP)
Initial body weight (kg)	9.33	9.00	8.67
Final body weight (kg)	8.87	11.00	11.00
Total body weight (kg)	-0.66±0.88 ^c	2.00±0.58 ^{ab}	2.33±0.88 ^a
Average daily gain (g)	-13.5 ^c	40.8 ^{ab}	47.6 ^a
Body length(cm)	1.33±0.88	2.67±0.88	2.33±0.88
Wither height(cm)	2.67±0.33	1.33±0.67	1.00±0.58
Heart girth(cm)	1.33±0.67	1.00±0.58	1.00±0.58
Mortality	-	-	-

abc: means within the same row with different superscripts are significantly different

The haematological analysis as shown in Table 3 indicates that the initial and final analysis on the pack

cell volume and the white blood count were significantly different ($P < 0.05$).

Table 3 : Haematological analysis of the WAD sheep fed cassava leaf silage and cassava peel

Parameters	Initials			Final		
	T1	T2	T3	T1	T2	T3
PCV (%)	31 ^b	27 ^b	31 ^b	23 ^a	23 ^a	25 ^a
WBC ($\times 10^6/\text{cm}^3$)	5.5 ^a	6.06 ^a	7.76 ^a	9.83 ^b	11.43 ^b	10.23 ^b
Lymphocyte	68	57 ^a	63	72	75 ^b	65
Neutrophil	32	43	37	28	25	35

abc: means within the same row with different superscripts are significantly different ($P < 0.05$)

There was a significantly different ($P < 0.05$) between the initial and final PCV also, the white blood count was significantly different ($P < 0.05$). The final WBC count although higher was within the normal range for sheep similar to (Reece & Swenson, 2004). According to Olorunnisomo et al (2012) the white blood cells count is an indicator of immune response to infectious or toxic substances in the organism and a high count is an indication of pathogenic infection or presence of antigens in the organism. The final lymphocyte count in T2 was higher and the neutrophil was relatively low. However, the animals were apparently healthy.

This study showed that the two feeds sustained the body weight of the animals and there was no adverse effect on the production parameters measured and the animals were apparently healthy. Sheep in the control recorded a loss in body weight during the period of experiment. It is therefore, recommended to supplement animals with cassava leaf silage and cassava peels during the dry season when feed scarcity can be a challenge.

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Challenges of Small Poultry Farms in Layer Production in Ibadan Oyo State Nigeria

By Aromolaran Adetayo K., Ademiluyi I.O. & Itebu O. Jennifer

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Abstract - The study assessed constraints to increased layers production among small-scale poultry farmers in Ibadan Area of Oyo State Nigeria. Data were collected using a multistage sampling technique to select 120 small-scale poultry farmers. Descriptive statistics (frequencies counts, percentages) were used to describe the socio-economic characteristics of the respondents. Correlation analysis was used to test the hypothesis. The Result shows that the mean age of the respondents was 48 years and majority (77.5%) of the farmers had higher education. Majority of the respondents (73%) practiced sweeping and packing of dirt in the poultry house as the daily routine management on their farms. The major constraint faced by the respondents was disease and pest attack (76.7%) followed by difficulty in credit and loan procurement processes (73.3%). Correlation analysis showed that there was significant relationship between income from sale of egg, number of birds raised and constraints to increased layers production among the small-scale poultry farmers ($r = 0.016, 0.014 P < 0.05$). The study therefore recommends that Government should tackle the problem of loan/credit procurement, market price instability, disease and pest as well as proper funding of small-scale layers poultry business so as to enhance the commercialization of poultry industry in Nigeria.

Keywords : *small-scale poultry, increased layers production, perceived benefit.*

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Challenges of Small Poultry Farms in Layer Production in Ibadan Oyo State Nigeria

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Abstract - The study assessed constraints to increased layers production among small-scale poultry farmers in Ibadan Area of Oyo State Nigeria. Data were collected using a multistage sampling technique to select 120 small-scale poultry farmers. Descriptive statistics (frequencies counts, percentages) were used to describe the socio-economic characteristics of the respondents. Correlation analysis was used to test the hypothesis. The Result shows that the mean age of the respondents was 48 years and majority (77.5%) of the farmers had higher education. Majority of the respondents (73%) practiced sweeping and packing of dirt in the poultry house as the daily routine management on their farms. The major constraint faced by the respondents was disease and pest attack (76.7%) followed by difficulty in credit and loan procurement processes (73.3%). Correlation analysis showed that there was significant relationship between income from sale of egg, number of birds raised and constraints to increased layers production among the small-scale poultry farmers ($r = 0.016, 0.014$ $P < 0.05$). The study therefore recommends that Government should tackle the problem of loan/credit procurement, market price instability, disease and pest as well as proper funding of small-scale layers poultry business so as to enhance the commercialization of poultry industry in Nigeria.

Keywords : small-scale poultry, increased layers production, perceived benefit.

1. INTRODUCTION

Challenges of food insecurity and hunger worldwide and in developing countries like Nigeria in particular have continued to receive attention from experts and governments. (Emaikwu *et al.* 2011, FAO2003). Consequently, several conferences and world Food summit on human nutrition have brought to the fore deliberations on issue of eradicating poverty and hunger. FAO (1995) asserted that, the most critical in the global food basket crisis is animal protein. In Nigeria, the major source of animal protein is the livestock industry. Over the years, the contributions of the livestock sub sector to Gross Domestic Product (GDP) have decreased from 5.61% in 1960 to about 2.64% in 2010 (CBN 2010). The contributions of livestock to Agriculture in 1999 and 2010 remain at 2.64% (CBN, 2010). Livestock production constitute an

important component of the agricultural economy in developing countries and it is an instrument of socio economic change, improved income and quality of rural life in Nigeria (Okumadewa 1999).

Poultry production as an aspect of livestock production is important to the biological needs, economic and social development of the people in any nation (Oladeebo and Ambe-Lamidi 2007). However, the contribution of poultry production (meat and eggs) to total livestock output increased from 26% in 1995 to 27% in 1999 with an increase in egg production alone accounting for about 13% during the period (Ojo, 2003).

The development of the poultry industry has also been described as the fastest means of bridging the protein deficiency gap prevailing in most of the developing countries. The poultry industry, if properly harness can also serve as a source of foreign earnings complementing crude oil which at present constitutes the main source of foreign earnings in Nigeria (The poultry site news 2009). In poultry production small-scale poultry production represents one of the few opportunities for saving, investment and security against risks. It accounts for approximately 90% of total poultry production (Branckaert 1999).

Despite the acknowledge importance of poultry production Akanni (2007) opined that it is characterized by low production level due to limited finance for the procurement of basic poultry equipment and materials. The result of this is that many of the small-scale poultry farmers are not encouraged to increase their productivity; thereby moving from small-scale production to a large scale production by small-scale poultry farmers encountered hindrances in the poultry industry which could be detrimental to increase poultry production. Based on this background, the study examined specifically the following objectives:

- Describe the socio-economic characteristics of the small-scale poultry farmers,
- Identify the daily routine management practices among small-scale poultry farmers,
- Examine perceived benefits to increased layer production among small-scale poultry farmers
- Examine constraints to increased layer production among small-scale poultry farmers.

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II. HYPOTHESIS

There is no significant relationship between the socio-economic characteristics of the small-scale poultry farmers and the constraint to increased production among the small-scale poultry farmers.

III. MATERIAL AND METHOD

a) Study Area

Oyo state is one of the states in South west Nigeria, Ibadan is the capital of Oyo state and the largest single city in southwest Nigeria. At Nigerian independence, Ibadan was the largest and most populous city in the country and the third in Africa after Cairo and Johannesburg. Ibadan is located in south-western Nigeria, 128 km inland northeast of Lagos and 530 km southwest of Abuja, the federal capital, and is a prominent transit point between the coastal region and the areas to the north. Ibadan has a population of 1,338,659 according to the 2006 census. Ibadan has a tropical wet and dry climate, with a lengthy wet season and relatively constant temperatures throughout the course of the year. Ibadan's wet season runs from March through October. The mean total rainfall for Ibadan is 1420.06 mm, falling in approximately 109 days. There are two peaks for rainfall, June and September. The mean maximum temperature is 26.46 C, minimum 21.42 C and the relative humidity is 74.55%.

b) Sampling Procedure and Sample Size

From the four agricultural zones in Oyo state Ibadan/Ibarapa zone was purposively selected because of the presence of small-scale poultry farmers in the zone. From the selected zone, 3 blocks was randomly selected. 2 cells was selected using simple random technique to make up 6 cells. Two villages was randomly selected from each of the 6 cells to make up 12 villages, from each of the 12 villages 10 small-scale poultry farmers was randomly selected to make up 120 small-scale poultry farmers. The total sample size for the study was 120 small-scale poultry farmers.

c) Measurement of Variables

Some of the important variables measured were:

Daily routine management practices: this was measured using 3 point scale ranging from Always = 3, sometimes = 2, Never = 1.

Perceived benefit was measured as Strongly Disagree =1, Disagree =2, Undecided = 3, Agree =4, Strongly Agree =5.

Constraints to increased layers production was measured with 3 point scale: Major constraint =3, Minor constraint =2, Not constraint =1.

d) Data Analysis

Data collected was subjected to descriptive and inferential statistics; frequency, percentages and means

was used to describe data collected, while PPMC was used to test the hypothesis; to ascertain for any relationships between selected socio-economic characteristics of respondents and their constraints to increased layers production

IV. RESULT AND DISCUSSION

a) Socioeconomic Characteristics of the Respondents

Table 1 indicates that most (62.5%) of the respondents were between the ages of 21-40 years while 15.8% are between the ages of 41-60. This implies that small scale layers poultry farming is common among younger farmers unlike those who are above 60 years which represent 1.7% of the respondents in this study. The ages ranges from 21 to 40 years indicates that majority of the respondents were within the economically active age category and this is in line with Yinusa (1999) who observed that this age bracket contains the innovative, motivated and adaptable individuals. Table 1 indicates that 63.3 percent of the respondents were married while 29.2% and 7.5% are single and widowed respectively. Most (77.5%) of the respondents had higher education which could probably have encourage them to choose poultry farming not regarding the technicality involved in it although at a small-scale level. Most (63.3%) of the respondents had more than 2 people in the household. It implies that respondents with family size above 2 people would have more hands to work in their poultry which could aid increase in their output. Sonaiya (2007) stated that family poultry contributing 68.9% of the total poultry meat produced in Nigeria. Only 2.5 percent of the respondents generate above 60,000 naira per month from their poultry business. This agree with Akanni (2007) who stated that low income from poultry business is one of the constraints to increased productions faced by small scale poultry farmers.

Table1 also indicated the level of experience of the respondents; 65% of the respondents had less than 5 years' experience while 10% had above 10 years of experience. Little years of experience could be the reason for low layer production among the small-scale layer farmers. The knowledge on management, which is a key to profitable poultry production, is gained through years of experience of the poultry farmer (Fetuga 1992). Majority (99.2%) of the respondents were raising below 50 birds as the time of this research. According to Akanni (2007) most small-scale poultry farmers have limited finance to raise larger number of flocks.

b) Daily Routine Management Practices

Table 2 shows that 73 percent of the respondents always sweep and pack dirt's within and outside the layers house, 56 percent of them always clean the water troughs and refill it daily, 45.5 percent sometimes weigh and measure the quantity of feed

given to the layers. Although, 65.5 percent of the respondents sometimes cull unhealthy birds but 61.5percent of the respondents do not practice foot dip system at the layers house. This implication of this is that small scale poultry farmers sometimes ignore some management practices as not important which could have hazards effect on their layers production performances. Most (61%) of the respondents keep records of egg laid for the day, this will help them to have adequate knowledge of the number of egg produced and also know the likely number of layer that are yet to produce after reaching the laying age. Separation of cracked egg was one of the daily routine management practices carried out by 71 percent of the respondents. This is necessary so as to prepare the eggs that were not cracked for sale each of the day. Since, cleaning and preparing the egg for sale will generate income; most of the layers farmers would always be willing to engage in such management practices. Good management practices are the minimum care that is required to humanely maintain the birds. Caring for the birds and tending to their basic needs is a constant responsibility-24 hours a day, 7 days a week (Claucer, 2010).

Table 1 : Socio -economic characteristics of respondents

Variables	Frequency	Percentage
Sex		
Male	73	60.8
Female	47	39.2
Age (years)		
Less than 20	24	20
21 – 40	75	62.5
41 – 60	19	15.8
Above 60	2	1.7

Marital status		
Single married	35	29.2
Married	76	63.3
Widowed	9	7.5
Level of education		
No formal education	3	2.5
Adult literacy	1	0.8
Primary education	17	14.2
Secondary education	6	5.0
Higher education	93	77.5
Family size		
1	9	7.5
2	35	29.2
More than 2	76	63.3
Monthly income		
Less than 20,000	63	52.5
20,000 – 40,000	43	38.3
41,000 – 60,000	8	6.7
Above 60,0000	3	2.5
Years of experience		
Less than 5 years	78	65
5 – 10 years	30	25
Above 10 years	12	10
Number of birds		
20 – 30	68	56.7
31 – 40	25	20.8
41 – 50	17	14.2
51 – 60	10	8.3

Source : Field Survey (2012)

Table 2 : Daily Routine Management Practices

Daily Routine Management Practices	(A)%	(S)%	(N)%
Sweeping and packing dirt within and outside the layer house.	73.0	20.0	7.0
Thoroughly clean water troughs and refill with clean water.	56.0	40.7	3.3
Weigh/measure the quantity of feed given to the layers.	20.9	45.5	33.6
Add fresh feed into the feed troughs.	63.8	33.8	2.4
Collect eggs at least three times a day.	56.7	40.5	2.8
Keep records of eggs laid for the day.	61.4	33	5.6
Check for sick layers	25.5	66.8	7.7
Cull unhealthy layers from others.	29.2	65.5	6.3
check for mortality and remove them	47.5	51.5	1.0
Change the foot dip.	15.5	23	61.5
Record number of unhealthy birds and drug administered	23.3	19.2	58.5
Separate cracked eggs, leakers and thin-shelled eggs after gathering.	71.4	27.6	1.0

NB: A=Always. S=Sometimes. N=Never.

Source: Field Survey (2012)

c) *Perception of the Layers Farmers on Benefit of Increased layer Production*

From Table 3 most (60%) of the respondents strongly agreed that the increases in the number of layers will help to increase profit that will be made from the poultry business. More than half of the respondents perceived that increase in the layers production will increase the egg production, poultry meat availability and more poultry droppings would be produced which could be used as manure to boost agricultural production. They also agreed that increase in layer production will improve well-being of the farmer's household. Village chickens play a very important role in the livelihoods of those people keeping them. These chickens have a multitude of functions, and these include the many cultural and traditional roles, food and income generation (Scoones 1992; Kusina and Kusina

1999). At least 40 percent concurred that increase in layer production could create job opportunity because it will require more labour to handle the increase in the poultry business. Among the respondents (26.7%), strongly disagree that there is adequate government policy for that could support them to boost their layer production and 33.3% of the respondents also disagree that loans are easily accessed when their layer productions increases. This implies that the fact that one has a large number of egg producing birds do not guarantee that one will have access to loan. Some (20%) of the respondents strongly agree that with increase in layer production there is more possibility that they will have access to loan because their large number of birds can encourage the funders to finance their business.

Table 3 : Perceived Benefit to Increased production of Layers in the study Area

S.N	Perceived Benefits	SD Freq %	D Freq %	U Freq %	A Freq %	SA freq %
1.	Increase in number of layers increases profit/income.	2 1.7	33 27.5	2 1.7	23 19.2	60 50.0
2.	Increase in number of layers increases egg production.	15 12.5	20 16.7	8 6.7	31 25.8	46 38.3
3.	Poultry meat production increases with the increased number of layers reared.	16 13.3	15 12.5	18 15	48 40	23 19.2
4.	There is more supply of poultry droppings for manure with the increased number of layers reared which can boost organic agriculture.	26 21.7	5 4.2	25 20.8	38 31.7	26 21.7
5.	Well-being of the farmer and his family improves when the number of layers increases.	23 19.2	14 11.7	21 17.5	32 26.7	30 17.5
6.	Less amount of money is spent in transporting of the layers and eggs when the number of layers increases.	27 22.5	42 35	11 9.2	30 25.0	10 8.3
7.	Increase in the number of layers reared will improve the protein consumption rate in the economy.	20 16.7	38 31.7	11 9.2	38 31.7	13 10.8
8.	Loans and credits are easily accessed when the number of layers reared increases.	26 21.7	40 33.3	8 6.7	36 30	10 8.3
9.	There is adequate government policy intervention for poultry farmers rearing an increased number of layers.	32 26.7	28 23.3	19 15.8	25 20.8	16 13.3
10.	Job opportunities increases with the increase number of layers reared.	4 3.3	8 6.7	60 50	24 20.0	24 20.0

NB: SD = Strong Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

d) *Constraints to Increase of Layers Production*

Table 4 Shows that 76.7% of the respondents poultry was faced with diseases and pest attack as a major constraint, this is probably because most of small scale poultry farmer could not identify the symptoms of disease earlier enough to prevent disease outbreak which is a major threat that wipe out many of the poultry in developing countries. Most (73.3%) of the respondents were also faced with uneasy access to loan and credit procurement; this was in line with reports

of Agbato,1997; Akeeb, 1997; Adebayo and Adeola (2005) also confirmed that credit facilities or loans from financial institutions are not accessible to the poultry farmers in the rural area. Market price fluctuation and non availability of land and space were also pointed by the respondents as constraints to increase of layer production. Meanwhile, 56 percent of the respondents lack technical knowledge required in the poultry business, Olaniyi *et al.* (2008) opined that lack of technical knowledge is a major constraint that militates

against poultry production. More than 55.8 percent of the respondents indicated that rate of mortality of their laying is a major constraint to increase their layer production. This concurs with Chitate and Guta (2001) and Smith (1992) who also observe that mortality was the major constraint to village chicken productivity. Lack of quality ingredient for feed formulation was also indicated by 55.8 percent of the respondents to be a major constraint while 51.7 percent believed that the high cost of feed for their layering birds was a major constraint encountered which prevented them from increasing their layers production. The high cost of feed

could be linked also to the lack of quality ingredient for feed formulation because the available quality ingredient may be costly and thereby affecting the price of the feed. The implication of this is that if the cost of feed is high and small scale poultry farmer could not afford it then it will affect the number of birds they can keep. Lack of feed for the mother hen and the chicks was the main reason for not confining poultry birds, chick confinement has been known to reduce losses from predators; however, it comes at a cost to the farmer in terms of increased feed (Sonaiya and Swan, 2004).

Table 4 : Constraints to Increase in Production of Layers

Constraints	Major Constraints		Minor Constraints		Not Constraints	
	Freq	%	Freq	%	Freq	%
Disease and pest attack	92	76.7	27	22.5	1	0.8
Cost of drugs and vaccination	72	60.0	45	37.5	3	2.5
Market/price fluctuation	70	58.3	36	30.0	14	11.7
Accessibility of feed	51	42.5	45	37.5	24	20.0
Availability of labour	25	20.8	36	30.0	59	49.2
Unavailability of land/space	30	25.0	69	57.5	21	17.5
Difficulty in credit and loan procurement processes	88	73.3	20	16.7	12	10.0
Purchase of healthy day old chicks	65	54.2	36	30.0	19	15.8
Cost of feed	62	51.7	50	41.7	8	6.7
Rate of mortality of the layers	67	55.8	49	40.8	4	3.3
Packing and disposal of the layers droppings	56	46.7	48	40.0	16	13.3
Lack of quality ingredient for feed formulation	67	55.8	44	36.7	9	7.5
Lack of technical know-how in handling poultry	68	56.7	35	29.2	17	14.2

Source: Field Survey (2012)

e) Possible Solutions to the Constraints to Increase Layers Production

Table 5 indicates the respondents' likely solution to the various constraints that affect the increase in production of layers. About 50 percent of the respondents indicated that provision of easy access to loan procurement will proffer solution to the constraints they are facing in increasing layer production. This is in line with Haruna *et al.* (2007) who opined that small-scale layer farmers do not have adequate capital and resources to expand their scale of operations. Some (24.2%) of the respondents pointed out that stable market price for the sale of egg could also encourage poultry farmers to increase their production since they are assured that they will be able to sell their eggs at a good price to the people irregardless of season they produce more egg because there is stable market price for the sale of egg. Provision of adequate land and space for poultry production was suggested as a solution by 16.7 percent of the respondents, although it is a few proportion that indicated that provision of land/space will assist in increasing layers poultry production but it is a vital suggestion because without land, poultry farms cannot be established and where it

is proposed to be sited close to residential buildings most of the times the residents of such area protest about the location of poultry in their neighbourhood. Knowledge and technical know-how in any business is very important so as to be able to handle such business properly and efficiently, 10.8 percent of the respondents indicated that adequate training should be provided so as to educate and enlighten the farmers. Meanwhile, only 4.2% of the respondents indicated that the provision of quality ingredients for poultry feed will proffer solutions to the constraints faced by the farmers.

It is probably because many of the small-scale poultry farmers mostly at times purchase feed they utilized for their birds. So if there is more supply of the quality ingredient for formulation and compounding, then the constraint of high cost of feed may reduce and the respondents will be able to buy either more of the ingredient for feed compounding or buy more feed to nourish their laying poultry birds production.

Table 5 : Possible Solutions to the Constraints to Increased Layers Production

Possible Solutions	Frequency	Percent
Easy access to credit/loan procurement	53	44.2
Stable market price for sale of egg.	29	24.2
Provision of adequate land/space for poultry production	20	16.7
Provision adequate training in handling poultry	13	10.8
Provide quality feed ingredients	5	4.2

Source: Field Survey (2012)

f) Result of Correlation Analysis

The result of correlation analysis shows that there was significant relationship between number of birds raised, income from sale of eggs and constraints to increased layer production. The implication is that the larger the size of layers raised by the poultry farmers impinge on the constraints encountered in increasing their layers poultry production. Likewise, if the income from sale of eggs is much and increasing, there is tendency that the small sale poultry farmers would be

willing to increase their layer production regardless of the constraints to increased poultry production. The age, years of experience and family size of the respondents were not significantly related to constraints to layers production. The age of the small scale poultry farmers and years of experience in the layer poultry business cannot prevent or reduce the kind of constraint they will encounter whenever they intend to increase their layers production.

Table 6 : Result of Correlation Analysis

Variable	Coefficient (r)	p-value	Decision
Age	0.301	0.786	NS
Years-of experience	0.011	0.904	NS
Number of Birds raised	0.226	0.014	S
Income from sale of eggs	0.220	0.016	S
Family size	-0.025	0.405	NS

S=Significant NS=Not Significant Source: Field Survey (2012)

V. CONCLUSION AND RECOMMENDATION

Challenges facing the small poultry farms especially the layers poultry farms impede the willingness of the poultry farmer to increase their production. The study established that majority of the respondents in the study area were young and educated which could help them to be innovative. They also perceived that there would be increase profit if they can increase their layer production which could help them to improve their wellbeing and raise their standard of living. Meanwhile some of the daily management practices that could promote hygiene were ignored and the major constraints that militating the increase of layer production as identified by this study were disease and pest outbreak, non availability of credit/loan facilities as well as the lack of technical know-how to handle the poultry profitable. It is therefore recommended that small-scale layer poultry farmers should be encouraged to form cooperative societies or join the existing one to be able to access loan to their business and government could also make fund available to assist the layers poultry farmers. Capacity training of poultry farmers to enable them to cope with the challenges of modern poultry farming and commercialization of small scale layers poultry production should be carried out.

Government should make policies specifically for transformation of the small scale poultry industry. This will assist in removing the challenges of small poultry farms and thereby creating a favourable environment to increase layer production among small holder poultry farmers.

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Effect of Organic Soil Amendments on the Activity of Sucking Pests of Chilli

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Abstract - Experiment was carried out under field condition at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to evaluate efficacy of different organic amendments superimposed with neem based pesticides against chilli sucking pests. Among different treatments, split application of neem cake @ 125 kg/ha + vermicompost @ 625 kg/ha at transplanting and 50 days later (with 50 per cent nitrogen) and Nimbecidine and NSKE spray interventions later was found to be the most effective treatment. The same treatment with 100% N resulted in significantly reduced activity of sucking pests and higher dry chilli yield (5.28 q/ha) with net return of Rs. 17492/-.

Keywords : organics, sucking pests, chilli, NSKE, nimbecidine.

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I. INTRODUCTION

Chilli (*Capsicum annuum* L.) is a tropical and subtropical crop grown all over India. In India, it is grown on an area of 9.08 lakh ha with an annual production of 10.70 lakh tonnes. Karnataka produces about 1.44 lakh tonnes of chilli from an area of 1.74 lakh ha (Singhal, 2003). Although, the crop has got greater export potentialities besides huge domestic requirement, a number of limiting factors have been attributed for low productivity. Among them ravages caused by insect pests are significant ones. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Anon., 1987). Amongst these, aphids, *Myzus persicae* Sulzer., *Aphis gossypii* Glover., thrips, *Scirtothrips dorsalis* Hood., and yellow mite, *Polyphagotarsonemus latus* Banks are the most vital production constraints. A total of 39 and 57 insect pests were recorded in Karnataka in chillies on nursery and field crop, respectively (Reddy and Puttaswamy, 1983 and 1984).

During the last two decades insecticidal control of chilli pests specially in irrigated crop characterized by high pesticide usage has posed problems of residues in the fruits (Awasthi *et al.*, 2001 and Joia *et al.*, 2001). The reported presence of residues of many insecticides including ethion, chlorpyrifos, cypermethrin, endosulfan and quinalphos has seriously affected the export of chillies. It is learnt that chilli consignments are detained at the ports of importing countries very often due to high pesticide usage in India.

Therefore, several issues are need to be reexamined, put to evaluation so that a sound management programme is evolved with least or no pesticide usage. Since the pesticide consumption in rainfed Byadagi chilli in North-Western Karnataka is much less vis-à-vis irrigated chilli, coming up in large area in Krishna river basin in recent years, development of a non-chemical package or a programme with least pesticide usage is need of the hour for rainfed Byadagi chillies coming from the traditional area of North Western Karnataka.

II. MATERIAL AND METHODS

An experiment to evaluate different organic amendments against chilli pests was designed for two seasons under field condition in deep black cotton soil during kharif 2004 and 2005. The trials were laid out in randomized block design. Seedlings of chilli cv. Byadagi kaddi were procured from the Main Agricultural Research Station, UAS, Dharwad and transplanted during 4th and 2nd week of July 2004 and 2005 respectively, in plots of size 4.5x4.2m with 90x60cm spacing. Each plot had a density of 48 hills with 2 plants per hill. There were 20 treatments, laid out in RBD and replicated thrice. The crop was raised by following recommended package of practices plant protection measures (Anon. 2004) and optimum plant stand was maintained during both the seasons.

The organics were incorporated in the field thoroughly a week before as well as 50 days after transplanting (DAT) of chilli seedlings. The spray operations were carried out with a knapsack sprayer. To compare the efficacy of the treatments, 100 per cent recommended dose of fertilizer (RDF) with four sprays of recommended package of practices (RPP) at 2nd, 5th, 7th and 11th week after transplanting (WAT) as chemical check and a control with no manure and chemicals were maintained.

The population count of aphids, thrips and mite count was taken at 70 and 100 DAT. For counting these, five plants were selected randomly in each plot and tagged. Six leaves on the top canopy of each selected plant were observed by using destructive sampling procedure.

Green chillies were harvested from entire plot separately and yield per plot was recorded during each picking. Total yield was calculated by adding the yield of each picking. The per plot yield was converted to

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quintals per hectare. Dry chilli yield was obtained from the green chilli yield as per the procedure given by Anon. (2004), with the ratio of conversion of green chilli to dry chilli being 10:1.

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment was worked out by deducting total cost of each treatment from gross returns. Total cost of production included both cultivation as well as plant protection charges.

Gross return = Yield x Market price

Net return = Gross return- Total cost

The data on mean population of sucking pests, was transformed to $\sqrt{x}+1$ and then subjected to one way ANOVA using M-STATC[®] software package. The treatment effect was compared by following Duncan's Multiple Range Test (DMRT).

III. RESULTS AND DISCUSSION

For the convenience of presenting results, treatment details listed in the following table are used with notations as given below.

Treatments	Details	Notations
T ₁	100% RDF, Neem cake 500kg/ha at transplanting (TP), Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 500-SS (Spray schedule)
T ₂	100% RDF, Neem cake 250kg/ha at TP, 250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 250/250 - SS
T ₃	100% RDF, Vermicompost 2500 kg/ha, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	VC 2500 - SS
T ₄	100% RDF, Vermicompost 1250 kg/ha at TP, 1250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	VC 1250/1250 - SS
T ₅	100% RDF, Neem cake 250 kg/ha + Vermicompost 1250 kg/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 250 + VC 1250 - SS
T ₆	100% RDF, Neem cake 125kg/ha + Vermicompost 625kg/ha at TP and at 50 DAT, Nimbecidine (5ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 125 + VC 625(2) - SS
T ₇	100% RDF, FYM 12.5 t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	FYM - SS
T ₈	100% RDF crop residue 5t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7 WAT, NSKE 5% at 11WAT	CR - SS
T ₉	50% N and 100% P&K, Neem cake 500kg/ha at transplanting, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N NC 500 - SS
T ₁₀	50% N and 100% P&K, Neem cake 250kg/ha at TP, 250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N NC 250/250 - SS
T ₁₁	50% N and 100% P&K, Vermicompost 2500 kg/ha, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N VC 2500 - SS
T ₁₂	50% N and 100% P&K, Vermicompost 1250 kg/ha at TP, 1250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N VC 1250/1250 - SS
T ₁₃	50% N and 100% P&K, Neem cake 250kg/ha + Vermicompost 1250 kg/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N NC 250 + VC 1250 - SS
T ₁₄	50% N and 100% P&K, Neem cake 125kg/ha + Vermicompost 625kg/ha at TP and at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N NC 125 + VC 625(2) - SS
T ₁₅	50% N and 100% P&K, FYM 12.5 t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N FYM - SS
T ₁₆	50% N and 100% P&K, crop residue 5t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N CR - SS
T ₁₇	100% RDF, RPP-two sprays of Dimethoate (1.7ml/l) at 2, 5 WAT and dicofol (2.5ml/l) + carbaryl (4 ml/l) at 7, 11 WAT	RPP

T ₁₈	Untreated check (100% RDF)	Control
T ₁₉	100 % RDF- Control for sucking pests (two sprays of carbaryl (4 ml/l) at 7 and 11 WAT)	Control (SP)
T ₂₀	100% RDF-control for <i>H. armigera</i> (two sprays of Dimethoate (1.7ml/l) at 2 and 5 WAT and two sprays of dicofol (2.5ml/l) at 7 and 11 WAT)	Control (H)

IV. ACTIVITY OF KEY PESTS

The results on the effect of organic soil amendments on the activity of chilli pests, in general indicated the effectiveness of organics in suppressing the pest activity *vis- a-vis* comparison treatments. The details are presented here under.

a) Aphids

At 70 DAT, $\frac{1}{2}$ N NC 125 + VC 625(2) - SS (T₁₄), recorded significantly less number of aphids (0.12 and 0.16 aphid / leaf) during 2004 and 2005 respectively. The treatments, NC 500-SS, NC 250/250-SS, VC 2500-SS, VC1250/1250-SS, NC 250+VC 1250-SS, NC 125+VC 625 (2)-SS, $\frac{1}{2}$ N NC 500-SS, $\frac{1}{2}$ N NC 250/250-SS, $\frac{1}{2}$ N VC 2500-SS, $\frac{1}{2}$ N VC 1250/1250-SS, $\frac{1}{2}$ N NC 250+VC1250-SS, $\frac{1}{2}$ N NC 125+VC 625-SS, RPP and control(H) recorded aphid count, ranging from 0.12 to 0.81 during 2004 and from 0.16 to 0.89 in 2005, respectively. However, all the treatments recorded significantly less number of aphids compared to control. Further, the aphid population was slightly on the higher side during 2005, compared to previous year. Maximum number of aphids of 0.81 and 0.89/leaf was registered in control during 2004 and 2005 respectively. Similar pattern of treatment significance was noticed in pooled data also (Table 1).

At 100 DAT, aphid count in different treatments ranged from 0.11 to 0.72 and 0.14 to 0.81 during 2004 and 2005, respectively. The treatment, $\frac{1}{2}$ N NC 125 + VC 625(2) - SS recorded significantly less number of aphids 0.11 and 0.14 during 2004 and 2005, respectively followed by T10. Moderate pest activity was recorded in treatments like FYM - SS, CR- SS and control (SP). Pooled data also revealed same pattern of treatment significance.

b) Thrips

At 70 DAT, among the different treatments, effect of $\frac{1}{2}$ N NC 125 + VC 625 (2) - SS (0.13) was found to be significantly superior, but being on par with T₁, T₂, T₃, T₄, T₅, T₆, T₁₀, T₁₁, T₁₂, T₁₃, T₁₇ and T₂₀ except FYM - SS (0.70) CR - SS (0.63), $\frac{1}{2}$ N NC 500 - SS (0.28), $\frac{1}{2}$ N FYM - SS (0.62), $\frac{1}{2}$ N CR - SS (0.52) and control (SP) (0.57) which registered lower pest pressure. However all the treatments were found to be superior over control during 2004.

Similar trend was also noticed during 2005 with thrips count varying from 0.30 to 1.19. Pooled analysis of the data also indicated similar trend of treatment significance.

At 100 DAT, significantly least thrips count numerically (0.11) was noticed on the crop receiving NC 125 + VC 625(2) - SS (T₆), $\frac{1}{2}$ N NC 250/250 - SS (T₁₀), and $\frac{1}{2}$ N NC 125 + VC 625(2) -SS (T₁₄), but were on par with rest of the treatments except control and control (SP) during 2004.

During 2005, thrips population varied from 0.28 to 1.12. All the treatments except control and control (SP) were found to be equally effective against the thrips. Pooled data also revealed a similar pattern of treatment significance (Table 2).

c) Mites

At 70 DAT, significantly less number of mites (0.15) was recorded in $\frac{1}{2}$ N NC 125 + VC 625 (2)-SS(T₆), being on par with rest of the treatments except control and control (sp) during 2004 which registered significantly higher pest activity (1.23 to 1.07) (Table 3).

During 2005, all the treatments (T₁, T₂, T₃, T₄, T₅, T₆, T₉, T₁₀, T₁₁, T₁₂, T₁₃, T₁₄, T₁₇, T₂) except FYM - SS, CR - SS, $\frac{1}{2}$ N FYM - SS, $\frac{1}{2}$ N CR - SS, control and control (SP) were found to be equally effective against mite. Pooled data also revealed a similar trend.

At 100 DAT, pattern of treatment significance was similar as that of 70 DAT, with the same organics and botanical sprays excelling over others.

d) Dry chilli yield

During 2004, significantly higher dry chilli yield (5.62 q/ha) was registered in the treatment, NC 125 + VC 625 (2) -SS and was on par with NC 250/250 - SS (5.26 q/ha), $\frac{1}{2}$ N NC 250/250 - SS (5.03 q/ha) and $\frac{1}{2}$ N NC 125 + VC 625 - SS (5.59 q/ha). While others were next in the order. Significantly less dry chilli yield (1.57 q/ha) was recorded in control and was followed by control (SP) (2.11 q/ha) (Table 4).

During 2005, yields recorded in different treatments were relatively less as compared to previous year, but the same treatment NC 125 + VC 625(2)-SS was found to be most superior by recording highest yield of 4.93 q/ha and was on par with rest of the treatments except VC 2500 + SS, FYM - SS, CR- SS, $\frac{1}{2}$ N NC 500 - SS, $\frac{1}{2}$ N VC 2500 - SS, $\frac{1}{2}$ N VC 1250/1250-SS, $\frac{1}{2}$ N FYM -SS, $\frac{1}{2}$ N CR-SS, RPP, control, control (SP) and control (H) which yielded in the range of 1.17 to 4.26 q/ha. All treatments were found to be superior over control, in yields realised. Pooled data also revealed similar pattern of treatment significance and from the point of yield. the treatments were of the order T₆ < T₁₄ < T₂ < T₁₀ < T₁ < T₄ < T₅ < T₉ < T₁₂ < T₁₃ < T₁₇ < T₃ < T₁₁ < T₇ < T₈ < T₁₅ < T₁₆ < T₂₀ < T₁₉ < T₁₈.

Among the different treatments (Table 5), highest net returns (Rs 17,812/-) was recorded by $\frac{1}{2}$ N NC 125+ VC 625 (2)-SS, followed by NC 125+VC 625(2)-SS (Rs 17,492/-) and NC 250/250-SS (15, 942/-). Whereas, RPP recorded net returns of Rs 13647/-.

Lower activity of target sucking pests in the crop amended with vermin-compost and neem cake could be attributed to changed biochemistry of the plant due to organic nutrition, which could probably make plant system defensive against pest infestation, possibly by induced resistance.

Role of vermicompost and neem cake in managing the sucking pests in chilli has been on record. Varghese and Giraddi (2005) reported that neem cake @ 500 Kg/ha along with 50% RDF in combination with two and three sprays of RPP was superior by suppressing activity of thrips and mites and ultimately resulted in reduction in chemical interventions in crop ecosystem. Similar results were also obtained by Giraddi and Smitha (2004) against chilli mite and Mallikarjun Rao and Ahmed (1986) against chilli thrips.

The literature available pertaining to the combined efficacy of organic ammendments and botanicals against sucking pests is scanty. However, Mallikarjun Rao *et al.* (1999b) reported that the soil application of neem cake @ 500 Kg/ha followed by seedling root dip with the per cent neem oil and neem oil emulsion spray later at weekly intervals significantly reduced the thrips population in chilli. Similar findings were also reported by the same author (1999a) against chilli aphids.

The present results on the utility of organics in pest management probably point induced resistance resulted due to variation in chemistry of the plant receiving organic amendments. This is supported by Surekha and Arjuna Rao (2001) who reported that induced resistance to pests and diseases is due to the higher polyphenol content in organic manure treated plants of okra.

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Determinants of Access to Credit among Rural Farmers in Oyo State, Nigeria

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Abstract - This study examined the determinants of credit access by rural farmers in Oyo state Nigeria. Specifically the study identified the socio-economic characteristics of the rural farmers, examined the factors affecting access to credit by the rural farmers, identified constraints faced by rural farmers in credit acquisition. Data were collected with the aid of structured questionnaires, administered on 210 respondents using multistage sampling procedure. The data were analyzed with the use of descriptive statistics and logit model. The sigma values of the binomial ($\sigma^2 = 90.32$) logit model that measured the significance of model showed that the data fit the model reasonably well. The binomial logit model revealed that significant relationships existed between sex (-2.0187), marital status (-1.9786), lack of guarantor (2.1517), high interest rate (6.8263) and access to credit. The variables were significant at 10%. It is concluded that there is need for financial institutions to help look into the conditions for obtaining credit by farmers, so that the less privilege among them will be able to benefit from credit disbursement especially in the aspect of high interest rate, guarantor and collateral security.

Keywords : rural, farmers, credit, socio-economics, logit.

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DETERMINANTS OF ACCESS TO CREDIT AMONG RURAL FARMERS IN OYO STATE, NIGERIA

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Determinants of Access to Credit among Rural Farmers in Oyo State, Nigeria

Ololade R.A.^α & Olagunju F.I.^σ

Abstract - This study examined the determinants of credit access by rural farmers in Oyo state Nigeria. Specifically the study identified the socio-economic characteristics of the rural farmers, examined the factors affecting access to credit by the rural farmers, identified constraints faced by rural farmers in credit acquisition. Data were collected with the aid of structured questionnaires, administered on 210 respondents using multistage sampling procedure. The data were analyzed with the use of descriptive statistics and logit model. The sigma values of the binomial ($\sigma^2 = 90.32$) logit model that measured the significance of model showed that the data fit the model reasonably well. The binomial logit model revealed that significant relationships existed between sex (-2.0187), marital status (-1.9786), lack of guarantor (2.1517), high interest rate (6.8263) and access to credit. The variables were significant at 10%. It is concluded that there is need for financial institutions to help look into the conditions for obtaining credit by farmers, so that the less privilege among them will be able to benefit from credit disbursement especially in the aspect of high interest rate, guarantor and collateral security.

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I. INTRODUCTION

Agricultural credit is very important for sustainable agricultural development to be achieved in any country of the world. Rural credit has proven to be a powerful instrument against poverty reduction and development in rural areas. Farmers are particularly in need of such instrument (ie credit), because of the seasonal pattern of their activities and the important uncertainty they are facing.

Agricultural credit enhances productivity and promotes standard of living by breaking vicious cycle of poverty of small scale farmers. Adegeye and Dittoh (1985) described agricultural credit as the process of obtaining control over the use of money, good and services in the present in exchange for a promise to repay at a future date. Imoudu and Onaksapnome (1992) contended that agricultural loan is a crucial input in small holder agriculture because it enables small scale farmers to establish and expand their farms as this would increase their income and ability to repay loan.

The crucial role of credit in agricultural production and development can also be appraised from the perspective of the quality of problems

emanating from the lack of it. In modern farming business in Nigeria, provision of agricultural credit is not enough but efficient use of such credit has become an important factor in order to increase productivity. Credit is not only needed for farming purpose, but also for family and consumption expenses especially during the off season period. Credit has also been discovered to be a major constraint on the intensification of both large and small scale farming (Von-Pischke, 1991). The role of agricultural credit in the agricultural development of a country cannot be overemphasized. One of the reasons for the decline in the contributions of agriculture to the economy is lack of a formal national credit policy and paucity of credit institutions, which can assist farmers (Olagunju and Ajiboye, 2010). The absence of rural banks or their unwillingness to meet credit need of rural farmers largely account for the wide influence of informal lending institutions on agricultural production in the rural areas.

In the developing countries, the role of agricultural credit is closely related to providing needed resources which farmers cannot source from their own available capital. In respect to this, the provision of agricultural credit has become one of the most important government activities in the promotion of agricultural development in Nigeria (Olagunju and Adeyemo, 2008). One of the reasons for the decline in the contributions of agriculture to the economy is lack of a formal national credit policy and paucity of credit institutions, which can assist farmers. Credit (capital) is viewed as more than just another resource such as labour, land, equipment and raw materials (Rahji, 2000). According to Shepherd (1979) credit determines access to all of the resources on which farmers depend. Consequently, provision of appropriate macroeconomic policies and enabling institutional finance for agricultural development is capable of facilitating agricultural development with a view to enhancing the contribution of the sector in the generation of employment, income and foreign exchange (Olomola, 1997). Despite the importance of credit to farmers, they still face some challenges in the acquisition of it which make most of them to get discourage and relent in their effort to contribute to the productivity of farm produce.

For this reasons this paper seek to give answers to the following questions.

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1. What are the socio-economic characteristics of the rural farmers?
2. In credit demand, what are its determinants by the rural farmers?
3. Do rural farmers face some constraints in credit acquisition?

a) *Objectives of the Study*

The general objective to this study is to examine the determinants of credit access by rural farmers in Oyo state.

The specific objectives are to;

- i. identify the socio-economic characteristics of the rural farmers.
- ii. examine the factors affecting access to credit by the rural farmers.
- iii. identify constraints faced by rural farmers in credit acquisition.

b) *Theoretical Framework*

i. *Concept of Credit*

The word 'credit' has been given several and varying number of meanings, some people refer to it as 'loan' while others used the term 'borrow' to qualify credit. Pischie *et al.* (1983), defined credit as a loan able fund which permits the purchasing of services, money or goods in the present, based upon the promise to pay for time at sometime in future. From this it can be inferred that credit provide the means for the temporary transfer of assets or the use of such assets from a man or organization that has them, to a man or organization that has not.

Baker and Hopkins (1979), however, made a clear distinction between credit and loan. He referred to credit as an assets or a financial reserve which the farmers can call upon when needed provided he has not used his credit 'asset' by exchanging it for a loan. When a farmer makes the exchange of his credit for a loan, then he starts incurring an interest charge, also he uses up part of his capacity and hence part of his ability to acquire additional liquidity in the future by borrowing.

Olajide (1981), defined credit as 'monetary' or financial aspect of capital resources: capital resources being broadly defined as goods employed but necessarily used up to the course of production. They went further to indicate that, it can take the form of: Money in cash or bank over drafts. In kind as forms of biological and physical capital purchase and supplied producers. Adegeye and Dittoh (1985), defined credit as the process of obtaining control over the use of money, goods and services in exchange for a promise to repay at a future date.

A credit transaction often requires the provision of some evidence of debt obligation in return for a loan, except in case of transaction between friends or relatives where loans was given based solely on good

reputation and financial position of borrowers. Evidence may take the form of mortgage on land, or buildings and pledging of trees or food crops (Adegboye, 1989).

Miller (1975) defines credit as a device for facilitating the temporary transfer of purchasing power from one individual or organization to another. Credits provide the basis for increased production and efficiency through specialization of function. Thus the skilled farm manager with small financial resources may be brought together with those with substantial financial resources but who lack farm management ability. The product of such a union will be more productive than the individual elements operating separately.

ii. *The Influence of Credit to Small Scale Farmers Production*

The World Bank (1996) opined that credit is necessary for small-scale farmers to increase their agricultural productivity and farm income; however their access to institutional credit is curtailed. Credit has done a thousand times more than enrich mankind than the gold mines in the world. However, merely recognition of credit as a condition for agricultural growth is not sufficient to guarantee increase agricultural productivity and farm income.

Modernizing agriculture requires large infusion of credit to finance the use of purchased inputs such as fertilizers, improved seeds, insecticides, additional labour and so on. In this regard, the provision of agricultural credit can be a powerful economic force for development if used to inject appropriate capital for the purchase of agricultural inputs that are not otherwise available to farmers from their own financial, physical and labour resources. To date, however, institutional supply of agricultural credit remains inadequate; and this continues to impede the transfer of technology and investment into agriculture (Olagunju and Ajiboye, 2010).

Osuntogun (1975) holds the view that 'unless production credit is made available on suitable terms, the majority of the small farmers will be seriously handicapped in adopting profitable technology. Also he outlined three reasons why credit is demanded by small scale farmers. These are:

The farmers require credit for production purposes; Credit is required for the payment of wages, procurement of inputs, like fertilizers, herbicides and improved seeds; Credit is needed for marketing of produce like transportation, storage, processing and other marketing related functions.

According to Ijere (1986), credit is a catalyst which drives the machinery of production to optimum performance. McNamara (1975), is of the opinion that access to credit is crucial to small scale farmers operations, no matter how realistic and essential the land reform. A well motivated farmer without credit

cannot buy improved seeds, fertilizers and chemicals. Hence the small scale farmer generally spend less than 20 percent of what is required on such items because they do not have access to credit disbursement.

Mbata (1991), opined that credit is pertinent to increase efficiency required by the small scale farmers. Harsch (1994) also, noted that farmers in Africa have demonstrated that when given the opportunity to earn higher incomes they can be dynamic producers. Kitbur (1990) submitted that modernization of agriculture demands increased use of modern inputs which consequently increase the demand for credit.

Galbraith (1952), contents that at a certain stage of agricultural development, agricultural credit clearly does not become a strong force for further improvement when a man with energy and initiative who lacks only resource for more and efficient production is enable by use of credit to eliminate the one block on his path to improvement and this is consistent with the views of Taylor *et al.*, (1986).

Perhaps the best known criticism of the effectiveness of providing credit to the small-scale farmers is attributed to Shultz (1964), who's poor but efficient hypothesis states, that the provision of agricultural credit will be ineffective in improving productivity and income, since investment is limited. Traditional farmers he hypothesized to be efficient but faced with technological barriers that cannot be overcome by the mere influx of capital provided by credit programmes alone. This view, does not discountenance the necessity of agricultural credit for the improvement of the productivity of the small-scale farmers, but rather stresses the need a combination of credit with other technological packages in order to increase production and income of the small scale farmers.

II. METHODOLOGY

a) Study Area

This study was carried out in Oyo State, Nigeria, mainly because a number of international and federal agricultural establishments are located in the state and because of its prominent agricultural activities being the primary occupation of the inhabitants of the state.

b) Sampling Technique

A multistage sampling technique was used to select 210 respondents from the state. Firstly, Ogbomoso agricultural zone was purposively chosen from the state, because majority of the populace makes farming their primary occupation and main source of income. The zone contains 5 blocks. Secondly, simple random sampling was used to select 3 cells from each block Random sampling was used to select 20 farmers each from 2 cells, 15 farmers each from ten cells, 10 farming household each from three cells. This selection

was based on the number of registered farmers available in each cell.

c) Analytical Techniques

Various analytical techniques were used for this study. Descriptive statistical tools were used to analyse the socio-economic characteristics of the farmers and constraints they face in credit aquisition. The farmers' access to credit was conceptualized to involve either access to credit or no-access to credit. Binomial Logit Regression model was used because the variable is a dummy variable.

d) Conceptual Framework

i. Binomial Logistic Regression

A Logistic model is a univariate binary model. We use a binomial logistic regression model given that the dependent variable is dichotomous: 0 when a farmer is having no access to credit and 1 when having access to credit. Predictor variables are a set of socioeconomic and demographic status indicators and dwelling endowment of the farmers. They contain both dichotomous and continuous variables. Let P_j denote the probability that the j -th farmer is having access to credit. We assume that P_j is a Bernouli variable and its distribution depends on the vector of predictors X , so that:

$$P_j(X) = \frac{e^{\alpha + \beta X}}{1 + e^{\alpha + \beta X}} \quad (ii)$$

The logit function to be estimated is then written as:

$$\ln \frac{P_j}{1-P_j} = \alpha + \sum_i \beta_i X_{ij} \quad (iii)$$

The logit variable $\ln\{P_j/(1-P_j)\}$ is the natural log of the odds in favour of the farmer having access to credit. Equation iii is estimated by maximum likelihood method and the procedure does not require assumptions of normality or homoskedasticity of errors in predictor variables.

III. RESULT AND DISCUSSION

a) Socio-economic Characteristics

Data collected from sampling of 210 farmers is made up of 133 (63.3 %) male and 77 (36.7%) female. This shows that majority of the rural farmers are males, which may be attributed to the intensive labour requirement. The respondents were either married or single; except for five respondents who were widowed. There was a high level of homogeneity in the distribution of farmers' marital status in the study area because of similarities in cultural and religious practices. The average age of sampled farmers was 48.47years indicating an ageing farming population. Meanwhile, over 80 percent of the respondents were young and still in their active working years. Most of the rural farming

household head have formal education (93.3%) and 6.67% have no formal education which may impede their acceptance of improved storage technologies since education facilitates farmers' adoption of innovations. 76.7% of the sampled population belongs to an average household size >5. Household size in the study area is fairly large with an average of 7 members and this is expected to have a multiplier effect on the poverty status of the respondents.

The average year of farming experience is approximately 23 years. Farming experience is an important factor determining both the productivity and the production level in farming. 67.14 percent of those surveyed are fully engaged in crop farming. This is closely followed by those engaged in livestock farming (22.38 percent). The distribution generally reveals the relative importance of crop farming as the main occupation and largest employer of labour in the study area. Over 50% of the farmers have secondary occupation while below average have no secondary occupation. Secondary occupation is very essential for farmers, it serve as extra source of income and it also help farmers to have income living on especially during the off season period.

Table 1.0 : Socio-Economic characteristics of Farmers

Gender	Frequency	Percentage
Male	133	63.3
Female	77	36.7
Total	210	100
MARITAL STATUS		
Single	13	6.2
Married	192	91.4
Widow	5	2.4
Total	210	100
AGE		
21-40	46	21.90
41-60	139	66.19
>60	25	11.91
Total	210	100

Educational Level		
Informal	14	6.67
Formal education (yr)	192	91.4
1-6	50	23.81
7-12	96	45.71
13-18	48	22.86
>18	2	0.95
Total	210	100
Farmexperience		
1-10	35	16.7
11-20	73	34.8
>20	102	48.6
Total	210	100
PrimaryOccupation		
Cropfarming	141	67.14
Livestock farming	47	22.38
Crop/Livestock farming	22	10.48
Total	210	100
Secondary Occupation		
Food processing	46	17.6
Civil servant	37	17.6
Artisan	41	19.5
No sec occupant	87	41.4
Total	210	100

b) Binomial logit Regression Analysis

The significant determinants of factors affecting access to credit by rural farmers are gender, marital status, guarantor and high interest rate. The study reveals that not being married reduces the probability of having access to credit by 86.3%. The study reveals that being a female reduces the probability of having access to credit by 71.3%. Farmers' access to credit is positively affected by availability of guarantor and a unit increase in interest rate leads to the probability of not having access to credit.

Table 2.0 : Binomial Logit Estimate of the factors affecting access to credit

Variable	Coeff	Std. Err	t-ratio	P-Value
CONSTANT	0500407	1.15316	0.433943	0.66433
PRIMOCC	-0.21525	0.272469	-0.70	0.429529
FAREXP	-0.00417	0.013925	-0.29953	0.764535
GENDER	-0.71307**	0.353228	-2.0187	0.04515
MARTSTA	-0.86318*	0.436252	-1.9786	0.047858
EDUCATION	-0.02991	0.030536	-0.97953	0.327316
GUARANTO	0.506192**	0.235258	2.15168	0.031425
COLLATER	-0.11113	0.309021	-0.35963	0.719123
HIGHINTE	1.93449***	0.283391	6.82625	8.72E-12
NETFAMINC	0.28277	0.293468	-0.96356	0.335267

*- 0.1 level of significance

** - 0.05 level of significance

*** - 0.01 level of significance

c) *Constraints facing Rural Farmers in Credit Acquisition.*

Table 16 shows that majority (73.3%) of the rural farmers acknowledged lack of collateral security as a problem, while about 54.3% realized lack of guarantor as a problem. Others are in the following order, high Interest Rate 51.9%, Mode of Repayment 28.6% and lack of information about the credit availability 23.8%. It

is clearly seen that, lack of collateral security, lack of guarantor, and high interest rate have above 50%. Mode of repayment and lack of information about the credit availability have below 50%. This implies that the first three problems are seen as the major problems while the last two are seen as the minor problems they face in credit acquisition.

Table 3.0 : Frequency and Percentage Distribution of Problems faced by Rural Farming Household in Credit Acquisition

Problems	Frequency *	Percentage
Lack of collateral security	154	73.3
Lack of guarantor	114	54.3
High Interest Rate	109	51.9
Mode of Repayment	60	28.6
Lack of information	50	23.8
Total	487	231.9

*- Multiple Response

IV. CONCLUSION

This study investigated the determinants of access to credit by rural farmers in Oyo State. The study revealed that gender, marital status, guarantor and high interest rate are the main factors determining farmers' access to credit in the study area. Also, lack of collateral security, lack of guarantor and high interest rate are the major problem the farmers are facing in credit acquisition.

Thus, there is need for financial institutions to help look into the conditions for obtaining credit by farmers, so that the less privilege among them will be able to benefit from credit disbursement especially in the aspect of high interest rate, guarantor and collateral security. In case of collateral security it is recommended that the household heads/respondents should form a cooperative group to enable them pull resources together or form a group to collect loan or credit from bank.

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Effect of Commercial Cold Storage Conditions and Packaging Materials on Seed Quality of Chickpea (*Cicer Arietinum.L*)

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Abstract - An experiment was conducted to know the effect of commercial storage conditions and packaging material on seed quality of chickpea Cv.JG11. The graded seeds were packed in three containers viz. gunny bag, polylined gunny bag (PLGB) and high density polythene bag (HDPE) and stored under two different storage conditions viz., ambient and commercial cold storage condition (temperature of 5-7 °C and 65-70 % RH) with initial seed moisture content less than eight percent and seeds were treated with thiram@ 2g/kg seed before storage. The different observations viz seed moisture content, germination (%), vigour index, electrical conductivity of the seed leachates, insect damage (%), incidence of seed borne diseases were recorded by following procedures prescribed by ISTA.

The results revealed that the seeds stored in commercial cold storage (5-7 °C + 65-70% RH) and packed in polylined gunny bag recorded higher seed germination (88.7%), vigour index (2799), seedling dry weight (430 mg), lower insect damage (1.7%), seed infection (4.5%), Electrical conductivity (0.25 micromhos/ cm) after 22 months of storage. Hence commercial cold storage structures can be effectively used for maintaining seed quality of chickpea during storage.

Keywords : chickpea, storage conditions, containers, seed quality, commercial cold storage.

GJSFR-D Classification : FOR Code: 091010, 070199



Strictly as per the compliance and regulations of :



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Abstract - An experiment was conducted to know the effect of commercial storage conditions and packaging material on seed quality of chickpea Cv.JG11. The graded seeds were packed in three containers viz. gunny bag, polylined gunny bag (PLGB) and high density polythene bag (HDPE) and stored under two different storage conditions viz., ambient and commercial cold storage condition(temperature of 5-7 °C and 65-70 % RH) with initial seed moisture content less than eight percent and seeds were treated with thiram@ 2g/kg seed before storage. The different observations viz seed moisture content, germination (%), vigour index, electrical conductivity of the seed leachets, insect damage (%), incidence of seed borne diseases were recorded by following procedures prescribed by ISTA

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I. INTRODUCTION

Chickpea (*Cicer arietinum.L*) is one of the most extensively grown rabi pulse crop in India. The Maintenance of seed quality during storage is most important and challenging in the crop due to problem of stored pests and quick loss of seed quality. In recent days several private organizations established the commercial cold storage with temperature of 5-7 °C and 65-70 per cent relative humidity for storage of dry chilli, chickpea and other pulses to preserve commercial marketable colour of the produce and it was observed that these storage conditions are better in controlling stored insects and incidence of diseases but regarding the status of seed quality, not much research work was carried out. With the view to evaluate these commercial cold storage structures with respect to seed storage and its effect on seed quality the present studies were under taken.

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II. MATERIAL AND METHODS

Freshly harvested seeds of chickpea Cv JG11 were graded and packed in three different storage containers viz. C₁- Gunny bag, C₂-High density polythene C₃- Polylined gunny bag (PLGB, 700 gauge),and stored in two storage conditions viz. S₁- Commercial cold storage (5-7° C and 65-70% RH) and S₂-Ambient storage. The seeds were treated with thiram @ 2g/kg of seeds before storage.

The different observations on seed moisture, germination, vigour index (germination % x seedling length(cm), electrical conductivity of seed leachets, insect damage and seed infection were taken at bi-monthly interval by following the procedure prescribed by ISTA (Anon 1999) and presented only four monthly data for convenience. The data obtained from the experiment was statistically analyzed by using factorial CRD the critical differences between the treatments were worked out at five per cent significance (Snedecor and Corchran, 1967).

III. RESULTS AND DISCUSSION

The data on percent seed moisture content observed during the studies in different treatment combinations was presented in Table1.It was observed that the values of seed moisture content varies with the storage conditions and packaging materials during the storage period. The initial seed moisture was less than eight percent in all the treatments. In general the extent of variation in seed moisture content was less in polylined gunny bag due to its impervious nature of pores followed by high density polythene bag and gunny bag over the storage period. Among the two storage conditions, there were not much significant differences were observed.

The results on the effect on the effect of storage condition and container and their interaction effect at different months of storage are presented in the (Table 2-7). The seed quality in terms of germination %, seedling vigour index, seedling dry weight were differed significantly between the storage conditions and containers during storage higher seed germination (88.7%), vigour index (2799), seedling dry weight (430 mg), lower insect damage(1.7%), seed infection(4.5%),

electrical conductivity (0.25 micromohs/cm) after 22 months of storage.

It was observed that the chickpea seeds stored in different storage conditions and containers significantly varied in respect of germination percent, vigour index and seedling dry weight. It was observed that the seeds stored in commercial cold storage condition recorded highest values (87% germination, 2551 vigour index and 423 seedling dry weight) as compared to ambient condition (14.5% germination, 144 vigour index and 163 seedling dry weight) after 22 months of storage. Among the different storage containers, the seeds stored in polylined gunny bag recorded highest values of seed germination, vigour index and seedling dry weight as compared to HDPE and gunny bag.

Further the seeds stored in commercial cold storage recorded lower insect damage (2.4%), seed infection (5.08%) and electrical conductivity (0.28 m.mohs/cm) and higher values in ambient storage (100 % insect damage, 39.67% seed infection and 0.49 m.mohs/cm of electrical conductivity). Among the storage containers studied, the seeds stored in poly lined gunny bag recorded lower insect damage, seed infection and electrical conductivity.

With respect to interaction, after 22 months of storage, the seeds stored in commercial cold storage along with poly lined gunny bag recorded higher values for seed germination, seed vigour index and seedling dry weight and lower insect damage, seed infection and electrical conductivity.

There was gradual reduction in seed quality parameters during storage in both the storage condition, but reduction process was relatively slower in commercial cold storage condition compared to ambient storage condition. This might be due to storage environmental conditions. The effect of storage longevity is negative on level of seed vigour varied between storage conditions. It could be correlated with difference amongst crops in expression of protective system of enzymatic processes which influence on intensity of seed deterioration. Longevity of stored seeds of any crops considerably depends upon the storage condition, primarily in terms of air temperature and relative humidity in storage. The results of this investigation regarding the use of different storage conditions were in conformity to those of Arulnandy and Senanayake (1991), Singh and Maurya (1972), Gupta and Shakya (1976) in Soyabean seeds. The probable reason for slow rate of reduction in germination and vigour in cold storage condition is due reduced rate of respiration and metabolic changes occurring in seeds as reported by Das *et al* (1998) in Rajmah seeds. Under ambient storage condition excessive leaching of electrolytes, soluble sugars and free amino acids occur as revealed by Doijode (1990) in onion seeds. With

passing of storage period vigour seeds decline due to catabolic activity going on seed and thus seed though viable reduction in length of shoot and root observed,

The main reason behind this is at low temperature (5-7 °C) there won't be any incidence of either insects and diseases, which in turn results in maintaining the higher seed quality parameters during storage and the observation of superiority of impervious container (polythene lined gunny bag) in seed quality maintenance in soybean is observed by Sharma *et al* of (1998) and Alan *et al* 2010 in Bean. Dwivedi and Shukla, 1990 in chickpea.

Finally from the present study the results clearly indicated that the commercial cold storage (5-7 °C temperature and 65-70 % relative humidity) can be effectively used for storing the chickpea seeds for 22 months of storage and among the different storage containers, the polylined gunny bag found better in maintaining the seed quality compared to either HDPE or gunny bag.

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Table 1 : Effect of storage conditions and containers on seed moisture(%) in Bengal gram / JG – 11 seeds during storage

Treatments	Storage period in months					
	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	10.1 (18.5) a	9.6 (18.0)	10.0 (18.4) a	10.1 (18.5) a	10.3 (18.7) a	10.3 (18.7) a
S ₂	9.5 (17.9) a	10.5 (18.9) a	10.50 (18.9) a	9.90 (18.3) a	10.1 (18.5) a	10.1 (18.5) a
CD (0.01)	0.645	0.588	0.628	0.564	0.693	0.693
C ₁	10.2 (18.6) a	11.1 (19.4) a	11.0 (19.3) a	10.80 (19.1)	11.1 (19.4) a	11.1 (19.4) a
C ₂	9.9 (18.3) a	10.2 (18.6) a	10.1 (18.4) a	10.1 (18.5)	10.1 (18.5) a	10.1 (18.5) a
C ₃	9.4 (17.8)	8.8 (17.2)	9.7 (18.1)	9.20 (17.6) a	9.5 (17.9)	9.5 (17.9)
CD (0.01)	0.790	0.720	1.088	0.978	0.849	0.849
S ₁ C ₁	10.6 (19.0) a	10.7 (19.0) a	10.4 (18.8) a	11.0 (19.3)	11.2 (19.5)	11.2 (19.5)
S ₁ C ₂	10.2 (18.6) a	9.6 (18.0)	9.9 (18.3)	10.0 (18.4)	10.3 (18.72) a	10.3 (18.72) a
S ₁ C ₃	9.5 (17.9) a	8.4 (16.8)	9.7 (18.1)	9.50 (17.9)	9.6 (18.0) a	9.6 (18.0) a
S ₂ C ₁	9.8 (18.2) a	11.4 (19.7) a	11.6 (19.9) a	10.7 (19.0)	11.0 (19.3)	11.0 (19.3)
S ₂ C ₂	9.5 (17.9) a	10.8 (19.1) a	10.5 (18.9) a	10.1 (18.5)	10.0 (18.4) a	10.0 (18.4) a
S ₂ C ₃	9.3 (17.7)	9.3 (17.7)	9.6 (18.0)	9.0 (17.4) a	9.5 (17.9) a	9.5 (17.9) a
CD (0.01)	1.117	1.018	1.088	0.978	1.200	1.200

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 2 : Effect of storage conditions and containers on seed germination(%) in cram Chickpea/ JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	96.1 (78.6)	95.0 (77.0)	95.1 (77.2)	92.5 (74.1)	90.4 (71.9)	87.0 (68.8)
S ₂	93.5 (75.2)	90.7 (72.2)	85.7 (67.7)	71.0 (57.4)	50.1 (45.0)	14.5 (22.3)
CD (0.01)	1.430	1.168	1.326	1.373	2.601	1.271
C ₁	93.8 (75.5)	92.1 (73.6)	89.2 (70.2)	76.1 (60.7)	64.8 (53.6)	49.1 (44.4)

C ₂	95.0 (77.0)	92.2 (73.7)	89.0 (70.6)	80.5 (63.7)	69.5 (56.4)	49.7 (44.8)
C ₃	95.7 (78.0)	94.3 (76.10)	93.0 (75.0)	88.7 (70.3)	61.0 (76.5)	53.6 (47.0)
CD (0.01)	1.760	1.047	1.624	0.588	4.506	1.557
S ₁ C ₁	95.5 (77.7)	94.7 (76.6)	95.0 (77.7)	90.7 (72.2)	89.0 (70.6)	86.5 (68.4)
S ₁ C ₂	96.0 (78.4)	94.2 (76.0)	94.5 (76.4)	92.2 (73.7)	90.7 (72.2)	86.0 (68.0)
S ₁ C ₃	97.0 (80.0)	96.2 (78.7)	95.7 (78.0)	94.5 (76.40)	91.5 (73.0)	88.7 (70.3)
S ₂ C ₁	92.2 (73.7)	89.5 (71.0)	83.5 (66.0)	61.5 (51.6)	40.7 (39.6)	11.7 (20.0)
S ₂ C ₂	94.0 (75.8)	90.2 (71.7)	83.5 (66.0)	68.7 (55.9)	48.2 (43.9)	13.0 (21.13)
S ₂ C ₃	94.5 (76.4)	92.5 (74.1)	90.2 (71.7)	83.0 (65.6)	61.5 (51.6)	18.5 (25.4)
CD (0.01)	2.488	2.023	2.297	2.378	4.506	2.201

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 3 : Effect of storage conditions and containers on seed vigour index in Chickpea/ JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	4135	4022	3897	3667	3041	2551
S ₂	4017	3088	3338	2157	719	144
CD (0.01)	166.66	177.01	239.699	74.785	84.79	124.705
C ₁	4036	3761	3487	2668	1685	1266
C ₂	4084	3802	3549	2830	1794	1275
C ₃	4109	4002	3816	3238	2161	1500
CD (0.01)	288.66	306.595	293.57	91.593	103.85	152.731
S ₁ C ₁	4032	3979	3809	3482	2825	2424
S ₁ C ₂	4162	3939	3879	3667	2970	2431
S ₁ C ₃	4212	4148	4003	3851	3328	2799
S ₂ C ₁	4040	3543	3166	1853	546	109
S ₂ C ₂	4005	3664	3221	1993	618	120
S ₂ C ₃	4005	3857	3628	2624	995	201
CD (0.01)	288.665	306.59	415.17	129.532	146.8	215.995

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 4 : Effect of storage conditions and containers on seedling dry weight(mg/5 seedlings) in Chickpea/ JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	449	448	445	432	428	423
S ₂	445	442	427	397	245	163
CD (0.01)	2.663	3.037	3.679	2.791	2.848	2.189
C ₁	448	441	434	411	321	289

C ₂	446	444	430	409	326	291
C ₃	449	450	446	423	362	299
CD (0.01)	3.261	3.720	4.506	3.418	3.489	2.681
S ₁ C ₁	449	445	444	431	423	420
S ₁ C ₂	448	447	442	428	423	419
S ₁ C ₃	451	454	449	438	433	430
S ₂ C ₁	447	438	424	390	215	158
S ₂ C ₂	447	441	418	391	230	162
S ₂ C ₃	447	445	442	409	290	168
CD (0.01)	4.612	5.261	6.372	4.834	4.934	3.792

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 5 : Effect of storage conditions and containers on electrical conductivity(micromohs/cm) in Chickpea/ JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	0.15	0.18	0.23	0.24	0.25	0.28
S ₂	0.17	0.22	0.28	0.34	0.36	0.49
CD (0.01)	0.010	0.080	0.044	0.014	0.016	0.036
C ₁	0.16	0.22	0.28	0.30	0.31	0.44
C ₂	0.17	0.20	0.26	0.30	0.31	0.39
C ₃	0.16	0.18	0.22	0.28	0.30	0.33
CD (0.01)	0.010	0.098	0.054	0.018	0.020	0.062
S ₁ C ₁	0.15	0.21	0.24	0.25	0.26	0.29
S ₁ C ₂	0.16	0.20	0.24	0.24	0.24	0.29
S ₁ C ₃	0.15	0.17	0.21	0.23	0.24	0.25
S ₂ C ₁	0.17	0.28	0.31	0.35	0.36	0.59
S ₂ C ₂	0.17	0.28	0.28	0.36	0.37	0.49
S ₂ C ₃	0.16	0.19	0.24	0.32	0.36	0.41
CD (0.01)	0.017	0.139	0.077	0.025	0.028	0.062

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 6 : Effect of storage conditions and containers on insect damage(%) in Chickpea JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	0.0	0.0 (0.5)	0.5 (4.05)	0.9 (5.4) a	1.33 (6.5.)	2.4 (8.9) a
S ₂	0.0	11.8 (20.09)	40.8 (39.7)	54.6 (47.6)	73.0 (58.6)	100.0 (90.0)
CD (0.01)	0.0	0.947	2.608	2.400	2.160	0.746
C ₁	0.0	14.1 (22.06)	25.25 (30.13)	31.5 (34.1)	40.2 (39.3)	51.5 (45.8) a
C ₂	0.0	3.8 (11.24)	36.13 (36.93)	38.8 (38.5)	40.8 (39.7)	51.2 (45.6) a
C ₃	0.0	0.5 (4.05)	0.75 (5.1)	13.0 (21.1) a	30.3 (33.4)	50.8 (45.4) a

CD (0.01)	0.0	1.16	3.194	2.940	2.646	0.914
S ₁ C ₁	0.0	0.0 (0.5)	0.2 (2.5)	0.7 (4.8) a	1.2 (6.2)	3.0 (9.9)
S ₁ C ₂	0.0	0.0 (0.5)	0.7 (4.8)	1.0 (5.74) a	1.5 (7.0)	2.5 (9.1)
S ₁ C ₃	0.0	0.0 (0.5)	0.7 (4.8)	1.0 (5.74) a	1.2 (6.2)	1.7 (7.4) a
S ₂ C ₁	0.0	27.7 (31.7)	50.2 (45.1)	62.2 (52.0)	79.2 (62.8)	100.0 (90.0)
S ₂ C ₂	0.0	7.2 (15.5)	71.5 (57.7)	76.7 (61.14)	80.2 (63.5)	100.0 (90.0)
S ₂ C ₃	0.0	7.2 (15.5)	0.7 (4.8)	25.0 (30.0)	59.2 (50.30)	100.0 (90.0)
CD (0.01)	0.0	1.641	4.518	4.158		1.292

MAS-months after storage

Figures in parenthesis indicate arc sin values.

Table 7 : Effect of storage conditions and containers on seed infection(%) in Chickpea JG – 11 seeds during storage

Treatments	2 MAS	6 MAS	10MAS	14MAS	18MAS	22MAS
S ₁	0.0	1.5 (7.04)	0.33 (3.14)	4.4 (12.1) a	4.92 (12.9)	5.08 (13.0) a
S ₂	0.0	5.25 (13.31)	5.67 (13.6)	20.9 (27.20)	34.1 (35.70)	39.67 (39.0)
CD (0.01)	0.0	1.58	1.153	2.492	2.700	2.285
C ₁	0.0	3.63 (10.9)	3.63 (10.9)	15.0 (22.7)	21.88 (27.8)	23.6 (29.0) a
C ₂	0.0	3.75 (11.09)	3.5 (10.7)	13.7 (21.7)	20.63 (26.9)	22.7 (28.4) a
C ₃	0.0	2.75 (9.46)	1.88 (7.7)	9.2 (17.6) a	16.0 (23.5)	20.7 (12.50) a
CD (0.01)	0.0	1.035	1.412	4.316	3.306	2.799
S ₁ C ₁	0.0	2.0 (8.1)	0.5 (4.0)	4.0 (11.5) a	5.25 (13.1)	5.2 (13.1) a
S ₁ C ₂	0.0	2.0 (8.1)	0.5 (4.0)	5.25 (13.1) a	5.5 (13.5)	5.5 (13.1) a
S ₁ C ₃	0.0	0.5 (4.05)	0.00 (0.50)	3.0 (9.9) a	4.0 (12.1)	4.5 (12.2) a
S ₂ C ₁	0.0	5.25 (13.18)	6.75 (15.0)	26.0 (30.6)	38.5	42.0 (40.4)
S ₂ C ₂	0.0	5.0 (12.9)	6.50 (14.7)	21.2 (27.4)	35.7	40.0 (39.2)
S ₂ C ₃	0.0	5.0 (12.9)	3.75 (9.6)	15.5 (23.19)	28.0	37.0 (37.4)
CD (0.01)	0.0	2.736	1.996	4.316	4.676	3.959

MAS-months after storage

Figures in parenthesis indicate arc sin values.

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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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