CHAPTER ONE

INTRODUCTION

Mung bean is botanically (*Vigna radiata* L. Wilczek).known as green gram, belongs to family leguminacease, subgenus ceratortropis, genus vigna phaseoleae and family is a self-pollinated, diploid plant with 2n= 2X=22 chromosomes)(Lambrides and Godwin 2007).Mung bean is one of the most important leguminous food crops in Asia.India is considered its native country but it's also cultivated in Pakistan Europe and USA (Imdad, *et.al.2012*).Philippin, thailand ,Bangladesh, Vietnam, Cambodia and Indonesia (Somashekaraiah,*et al*,1992).

Uganda (Apio ibedo ,2014) Australia and China (Imrie and lawn, 1991)as well as Egypt (Ashour, *et al* ,1994) and Iran (Paroda *et al* ,1987).India is the largest producer of mung bean in the world 54%, and producer higher forage(2.2 ton/ha) (Twidwel, *et al*, 1992).The average productivity is 550 kg/ha (Anonymous, 2008).In south Asia , improved varieties of mung bean are planted on an area of 3 million hectares with a total annual production of 3.1 million tons under rainfed and irrigated condition (Shanmugasund Aram, *et, al*,2009).In Pakistan it was planted on area of 2-5 million hectares with a total annual production of 1.8 million tons,with an average yield of 723kg /ha out of the total area of Pakistan Khyber –pakhtunkhwa covered an area of 10.1 thousand hectares with the production of 6.4 thousand tons giving an average yield of 634 kg /ha(Min fal, 2008-09). The average yield in Pakistan during the year 2009-10 was 70kg/ha (Ali *et al*, 2000).

In China mung bean is known as a healthy food and market demand for its product is increasing gradually. But unlike other major crops like rice (*Orayza sativa*) , maize (*Zea mays*) and wheat (*Triticum spp*) progress in

mung bean genetics and breeding has been far from being satisfactory (Cheng and tian 2011).

In Sudan mung bean is a new crop and it's going to be a commercially promising as population has increased and the cost of production of animal protein has soared.Its preferred but is economically out of reach for the bulk of population in both rural and urban areas. Fodder crops are crops that are cultivated primarily for animal feed. All types of fodder crop i.e. grasses, legumes and root crops are fed to animals, either as green, as hay, i.e. crops harvested dry or dried after harvesting, or as silage products(Wanas , *et al* .,2007).

Local production of pulses is not sufficient to meet the increasing demand for human utilization there for to meet the situation, its necessary to boost up the production in adequate supply of feed in quantity and quality is responsible for the low productivity of animals, the animal depended entirely on natural pastures for their food. This source is only adequate for their survival during the wet season but inadequate during the dry season.

This has resulted in the characterized limitation posed by non-availability of all – year- round feed resources due to prolonged dry season (Oladotun*et.al,* 2003, Odeyinka and Okunade. 2005).

There is need to improve pasture production through properly planned management and need for better forage cultivars that maintain continuous supply of forage. Such management practices include cutting management –introducing high yielding new crops with short growing season and proper management practice is considered as an effective tool for narrowing the food gap in Sudan as well as cultivation of mung bean and use of fertilizers(Odeyinka and Okunade. 2005).

Economic importance of green gram: Seed of green gram contains 25% protein, 1.15%, fat 62.6%, carbohydrates sprouted seed which are rich in vitamins are consumed as salt. Its flour is used in cakes and starch is used in making noodles.

Excellent green manure as it's easily decomposed when incorporated (biomass has 1.5% N).More over husk and split bean are useful as livestock feed seed are boiled and used in soups or made in to porridge with rice or wheat. When it used as forage makes a good cover crop and soil binde (Ibrahim, *et al.,* 2012).

The objectives of this study were to:

1- Determine the best seed rate to achieve high yield of mung bean *(Vigna radiata*).

2-Determine optimum dose of fertilizer for enhancing mung bean stover productivity.

3- Select the best varieties of the crop in terms of vegetative growth and yield.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and distribution

Mung bean(*Vigna radiata* L. Wilczek) has been grown in India since ancient times. It is still widely grown in southeast Asia, Africa, South America and Australia. It was apparently grown in the United States as early as 1835 as the Chickasaw pea. In China, mung bean is known as a healthy food, and market demand for its products is increasing gradually (Phoomthiasong, *et al*.,2003).

2.2 Description of the plant

Mung bean is an annual crop, cultivated mostly in rotation with cereals. (Oplinger, *et al*,. 1990).It looks more like a garden bean*(Phaseolus vulgaris*) than likea soya bean(*Glycin max*) plant. It is slightly hairy with a well- developed root system. Wild types tend to be prostrate while cultivated types are more erect (Lambrides, *et al*.,2006).

Mung bean roots are deep rooted just like the roots of black eye.Both upright and vine types of growth habit occur in mung bean stem with plants varying from 0,5 m to 1,3 m in length.The leaves are trifoliate like other legumes.The plant has pale yellow flowers, are borne in clusters of 12–15near the top of the plant. Self-pollination occurs, so insects and wind are not required. Flowers will eventually develop into small, thin cylindrical pods and, often, cylindrical seeds covered with a white rough layer. Pods colour varies from black and brown to pale grey when mature. Pods are7.5cm to10 cm long, each having 10 to 15 seeds. There are several pods clustered at a leaf axil, with typically 30 to 40 pods per plant. The pods turn darker in colour as they mature. The seeds are free

from glycosides. The seed colour exhibits a wide range of variations at maturity, from yellow,greenish-yellow, light-green and shiny green to dark-green, dull green,black, brown, and green mottled with black. The weight per 100 seeds is3–7 g. The seeds are variable in colour: they are usually green, but can also be yellow, olive, brown, purplish brown or black, mottled and/or ridged. Seed colour and presence or absences of a rough layer are used to distinguish different types of mung bean (Lambrides *et al*., 2006;Mogotsi,2006).

2.3 Economic importance

Legume fodder is important for livestock production because it is rich in protein, minerals, phosphorus, calcium and vitamins (Bogdan, 1977 and Unkovich, *et al.;* 1997). Mung bean is an important pulse crop having high nutritive value. Its seed contains 24.2% protein, 1.3 % fat and 60.4 % carbohydrate. It is a short duration crop and can be grown twice a year i.e. in spring and autumn seasons (Hussain *et al.,* 2011).It improves the nutrient statues of soil , it fixes atmospheric nitrogen at 50-100kg/ha annually (Rahim,*et al*.,2010).

The crop is widely used as human food, green manure and forage for livestock .It also serves for medicinal purpose (Hujjie *et al*.2003.Agugo.2003). Furthermore Health benefits of mung bean sare cooked fresh or dry.They can be eaten whole or made into flour, soups, porridge, snacks, bread, noodle and ice cream**.** Split seeds can be transformed into dhal in the same way as black gram or lentils. Mung bean can be processed to make starch noodles or soap. The immature pods and young leaves are eaten as a vegetable(Mogosti,2006).Several products of the crops are useful for livestock feeding (Vaidya,2001),also sometimes grown for fodder as hay, straw or silage(Mogosti,2006).

Mung bean protein is easily digestible and does not cause the flatulence as many other legumes do (Arif, *et al*., 2012,Hossein,*et al*., 2011 and Kasra, *et al*.,2011) because it has less sulpher containing amino acids with even less methionine than lysine.

2.4 Climatic requirements

2.4.1 Temperature

Mung bean is a warm season crop requiring 90–120 days of frost-free conditions from planting to maturity (depending on the variety). The optimum temperature range for growth is between 27 °C and 30 °C. This means that the crop is usually grown during summer. Seed can be planted when the minimum temperature is above 15 °C. It is responsive to daylight length. Short days result in early flowering, while long days result in late flowering. However, the plant varieties differ in their photoperiod response. It is considered to be heat and drought tolerant (Elhag,.2011).

2.4.2 Soil

Green gram does well on fertile, sandy loam soils with good internal drainage and a pH between 6.3 and 7.2. The crop requires slightly acid soil for best growth and does not tolerate saline soils as it triggers severe iron chlorosis symptoms and certain micronutrient deficiencies on more alkaline soil (Shah *et al.*,2006). Mung beans have phosphorus, potassium, calcium, magnesium and sulfur requirements similar to other legumes which must be met by fertilizer additions if the soil is deficient in these elements (Elhag,.2011 and Reed *et al.*,2007).

2.5Cultural practices

2.5.1 Propagation and Varieties

Mung beans are propagated through seeds. The varieties based on their seed size, can be classified into two groups. One is the bold- seeded varieties (50- 70g/1000seed), usually called philippino types and is predominantly grown in south east Asian countries. They have relatively higher yield potential (1-2t/ha), large foliage. These varieties usually fail in south Asian countries. The other is the small- seeded varieties (20-35g/1000seed) mainly cultivated in south Asian countries. they have relatively low yield potential (0.5-1.0 t/ha) but are fairly adapted to the local environmental conditions (Sabra, *et al.,* 2012).

2.5.2 Seed bed preparation

A well-prepared seedbed with good moisture content is preferred for mung beans. The soil should be tilled to remove weeds and to prepare a seed bed which will provide good seed soil contact. The final seedbed needs to be firm with a surface free of clods and debris to allow a good distribution of seeds (Oplinger*et al.,* 1997).

2.5.3 Planting and rate of seeding

Mung beans should be planted between late November and early December like other legumes. A population density of 200 000 to 350 000 plants per hectare under dry land conditions and 400 000 plants per hectare under irrigation is recommended. Seed should be planted 1 deep in a well prepared seed bed with good moisture content. If the surface layers are dry, this depth can be increased to 3 if the soil type is one which does not crust easily. The seedlings of mung beans can have a hard time breaking through a thick crust and stands will be reduced. Planting equipment for soybean field been (*Vicia faba)* and cowpea(*Vigna*

ungiculata)can be used to plant mung beans but careful adjustments must be made to properly deliver and distribute the very small seed(Elhag,.2011).In 30" rows the recommended planting rate is 9 seeds/ft, in 20 rows 6 seeds /ft. and in 6-10 rows 2-3 seeds /ft.

Population of 150.000- 200.000 plants per acre will be achieved with these rates. Because of possible weed outbreaks with early seasons planting and the need for cultivation to control them. Rows spacing's of (20-30) are needed. In later plantings or planting as second crop, the narrow rows will produces higher yields (Oplinger *et al.,* 1997).

2.5.4 Irrigation

Mung beans are sensitive to water logging and therefore require less water than many other crops. The most critical time of irrigation is during flowering and early pod filling. Irrigation depends on weather, soil and field conditions. Usually the first irrigation is required just after seedling emergence. Later, two to three more irrigations are applied at 10 to15 days' intervals during the dry seasons. Generally no irrigation is needed during the rainy seasons, except when drought occurs (Lal *et al.*,2001).

2.5.5 Fertilizations

DAP fertilizer is an excellent source of P and nitrogen (N) for plant nutrition. It is highly soluble and thus dissolves quickly in soil to release plant-available phosphate and ammonium. A notable property of DAP is the alkaline pH that develops around the dissolving granule.As dissolving DAP granules release ammonium, the seedlings and plant roots nearest the volatile ammonia can be harmed. This potential damage more commonly occurs when the soil pH is greater than 7, a condition that often exists around the dissolving DAP granules. To prevent such damage, users should avoid placing high concentrations of DAP near germinating seeds. Phosphate fertilizer is usually required at 5 to 10 kg/ha

on dry land crops and 10 to 20 kg/ha on irrigated crops. It is always advisable to conduct soil tests and follow the recommended applications, while considering the anticipated yield. If the soil pH is below 6, 3, lime should be applied to raise the pH to the desired level NPK improved mung bean yield (Ali *et al*., 1996; Ali *et al*., 2010). Among other macro nutrients Potash. (K) plays a vital role in photosynthesis, enzyme activation, protein synthesis and resistance against the pest attack and diseases (Arif*et al*., 2008). It plays a key role in activation of more than 60 enzymes (Tisdale *et al* 1990, Bushkh *et al*., 2011).

Nitrogen is essential for plant growth and is a part of every living cell. It directly increases the plant protein content. Nitrogen helps make plants green and plays a major role in boosting crop yields. It plays a critical role in protein formation and is a key component of chlorophyll.

Phosphorus is an essential nutrient for plant growth which stimulates blooming and seed formation (Akhtar *et al*., 1999). It plays a fundamental role in metabolism and energy producing reaction in plants. It is an integral part of nucleic acid, phytin and phospholipids and is essential for cellular respiration in the metabolism of the starch, protein and fats (Iqbal and Chauhan, 2003). Phosphate is made unavailable in arid soils principally as complex calcium compounds (Mehdi *et al*., 2003). With high rate of P fertilizer additions, soil sorption sites are satisfied and P level increases to sufficiency for crop production.

2.5.6 Weed control

Weed control is essential, because competition between the beans and weeds is reduced, therefore ensuring high yields. Black and hairy nightshade, yellow nut sedge and annual summer grasses are the major weeds that are encountered. Hand weeding at about 40 days after planting

is beneficial. Intertillage by hand should be performed once or twice. Rotatory hoeing should be performed as needed to remove weeds until flower initiation. Cultivation of damp plants should be avoided, because this could result in the spread of bacterial and fungal diseases(Josh,2016).

2.5.7 Pest and disease control

Pests: Aphids(*Aphis Craccivora*), Jassids(*Amrasca devatans*), Whiteflies (*Aleurodicus dispersus*) and pod borer(*Maruca vitrata*).

Insect pest control is also important if one wants to achieve high seed quality. Chemical control involving the use of chemicals is usually necessary, but care should be taken when choosing the insecticides and they should be applied at the right time in order to achieve maximum control.Mung bean, like any other leguminous plant, is susceptible to diseases caused by fungi, bacteria and viruses, Diseases: yellow mosaic,mosaic mottle, leaf crinkle, seed and seedling rot Cercospora leaf spot. Mosaic is transmitted by white flies (vector). (Aduayi 2002.)

2.5.8 Harvesting

Harvesting is done when pods are mature and dry, but before they start shattering. Manual harvesting is usually practiced, but mechanical harvesting can save on labor costs. Defoliation of the plant is needed before mechanical harvesting (Lal *et al.*,2001).When used as forage, the mung bean can be grazed six weeks after planting and two grazings are usually obtained(FAO,2012).It can be used to make hay, when it should be cut as it begins to flower and then quickly dried for storage. It is possible to make hay without compromising seed harvest.

CHAPTER THREE
MATERIALS AND METHODS

3.1 Experimental site and the climate

The field experiment was conducted in the summer season of (2016) in the demonstration farm of the College of Agricultural Studies at Sudan University of Sciences and Technology at Shambat Altitude 15^{o}-40^{o} N longitude 32^{o}-34^{o} E and altitude 28 meters above sea level in the semi-desert region. The soil of the experimental site is loamy soil with pH 7.5-8.7

Annual rainfall ranges from750-800mm occurring during July to September. Relative humidity ranges between 31-51 % during winter. (Khairy 2010 and Hamdon.2001)

3.2 Materials:

Seeds and fertilizer (Diamonium Phosphate)used in the experiment were obtained from the College of Agricultural Studies, Sudan University of Science and Technology. Shambat

3.3.1Experimental design and Land preparation:

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replicates, the main plots contained two mung bean varieties: (Beladi & C24). Subplots consisted of three seed rates, seed rate one(SR1-4Seed in hole),seed rate two(SR2-6Seed) was control, seed rate three(SR3-10seed).

Land was prepared using disc plough then disc harrowed, leveled and ridged up north - south. The field was divided in to three blocks (replicates), The space between ridges was 70cm and 20cm between

holes. Size of the plot was 3m ×4m. Sowing was done manuallyon the third week of March.

3.3.3 Treatments:

DAP Fertilizer was applied with sowing (d1), and then after month(d2). Weeds control was done by hand weeding two weeks after sowing and then when needed throughout the growing season. Irrigation was applied every seven to ten days according to temperature range and soil need.

3.3.4 Parameters:

3.3 .4.1 Vegetative growth characters

All vegetative growth characters were determined after 30, 45 and 60 days after sowing.from five randomly selected plants

3.3.4.1.1 Plant height (cm):

The mean plant height was measured from the soil surface to the last leaf using a tape meter.

3.3.4.1.2 Stem thickness(cm):

The mean stem thickness was taken by thread, and then measured the using ruler.

3.3.4.1.3: Number of branches/plant:

From five plants of mung bean, number of branches was counted and then the mean / number of branches was recorded.

3.3.4.1.4: Number of leaves/plant:

This character was determined by counting number of leaves / plant then the mean was recorded.

3.3.4.2:Plant Density:

Number of plants was counted from one meterlength in each plot randomly after 45days and the number of plants per meter^{2}was calculated.

3.3.4.2: yield parameters:

3. 5.2.1: Fresh weight:

The selected plants were cut above the surface of the soil after 50% flowering, and weighed.

3. 5.2.2: Dry weight

Samples were oven dried at 80c° for 24hours then weighed.

3.3.5 Statistical analysis:

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package program MSTAT-C (Gomez and Gomez.1984). Least significant difference test (L.S.D) at 5% probability level was applied to compare the differences among treatment means.

CHAPTER FOUR

RESULTS

4.1 Plant height (cm):

Analysis of variance in studied traits showed no significant differences among treatments on plant height, except seed rate which had significant effect ($p \leq 0.01$) (Table1).Seed rate of SR2(6kg/ha) resulted in maximum height (32.6).V1(baladi) variety had highest Plant height compared to V2 (C24) but this increment was not significant. Furthermore the interaction of treatments was not significant (Table 2).

4.2 Stem thickness (cm):

The results revealed that neither treatments nor their interaction had any significant differences on this parameter(Table1). Comparing between two verities it was observed that V2 (C24) Variety is superior recorded (0.41cm), and with respect to dose both of them gave similar result (0.41 cm) (Table 2).

4.3 Number of leaves/ plant:

With respect to number of leaves per plant the effect of varieties and doses showed highly significant differences (Table 1). V1 beladi Variety is lead to highest number of leaves (51), fertilizers doses (D1) at planting displayed significant effect compared with (D2) after planting (Table 2). Interaction of treatments (V1*SR2*D1) recorded the best result (Table 3).

Table (1) : Summary of the Analysis of Variance (ANOVA) of parameters Studied for mung bean underVarities, Seed rate and Application time,:-

Source of variation	Degree of freedom	F-Values				
		Plant height(cm)	Stem thickness (cm)	Number of branches	Number of leaves	Plant density
Replication	2	1.51	1.03^{NS}	0.98	0.61	1.20
Verities	1	2.62^{NS}	0.00 ^{NS}	9.4 5**	3.49*	4.78*
Seed rate	2	3.71*	0.09^{NS}	2.23^{NS}	0.78^{NS}	5.44*
Variety*Seed Rate	2	1.43^{NS}	1.12 ^{NS}	3.48*	1.40^{NS}	7.23**
Dose	1	0.04^{NS}	0.01^{NS}	4.32*	5.91*	0.17^{NS}
Variety*Seed Rate*Dose	2	0.25^{NS}	0.09^{NS}	1.01^{NS}	0.76^{NS}	0.40^{NS}
Stand error	22	1541.40	0.24254	4262.4	583.13	1486.82
Total	35					
(C.V%)		29.68	25.45	31.64	31.25	50.22

NS= non significant, ** = statistically significant at p= 0.05

Table (2) : Mean comparison of parameters Studied for mung bean under Seed rate and Varities:-

Treatments	Plant height(cm)	Number of leaves	Number of branches	Stem thickness (cm)	Plant density
SR1	28.675^{ab}	42.708^{a}	16.267^{a}	0.4148^{a}	19.300^{a}
SR 2	32.600^{a}	50.525^{a}	17.883^{a}	0.4204^{a}	19.823^{a}
SR3	23.333^{b}	38.742^{a}	15.275^{a}	0.4025^{a}	9.983^{b}
V 1	30.461^{a}	51.122^{a}	18.078^{a}	0.4122^{a}	19.364^{a}
V2	25.944^{a}	36.861^{b}	14.872^{a}	0.4130^{a}	13.373^{b}
D1	27.922^{a}	48.811^{a}	18.561^{a}	0.4146^{a}	16.941^{a}
D2	28.483^{a}	39.172^{b}	14.389^{b}	0.4105^{a}	15.797^{a}

The same letters in each column show non- significant differences at 5% L.S.D.SR=Seed rate, V=Verities, D= Dose fertilizer .

Table (3) : Interaction effects of Varities, Seed rate and of

Parameters Studied for mung bean:-

Treatments	Plant height(cm)	Number of leaves	Number of branches	Stem thickness (cm)	Plant density
V1*SR1*D1	27.300^{abc}	45.400^{ab}	18.400^{ab}	0.3910^{a}	15.700^{bcd}
V1*SR1*D2	27.900^{abc}	37.533^{bc}	14.300^{abc}	0.3908^{a}	19.600^{abcd}
V1*SR2*D1	34.000^{ab}	65.333^{a}	17.867^{ab}	0.4052^{a}	30.733^{a}
V1*SR2*D2	39.233^{a}	54.533^{bc}	20.300^{ab}	0.4087^{a}	29.453^{ab}
V1*SR3*D1	25.200^{abc}	62.067^{a}	22.633^{a}	0.4512^{a}	8.543^{d}
V1*SR3*D2	29.133^{abc}	41.867^{ab}	14.967^{abc}	0.4263^{a}	12.157^{cd}
V2*SR1*D1	31.467^{abc}	50.733^{ab}	18.867^{ab}	0.4547^{a}	23.433^{abc}
V2*SR1*D2	28.033^{abc}	37.167^{bc}	13.500^{bc}	0.4229^{a}	18.467^{abcd}
V2*SR2*D1	29.667^{abc}	44.833^{ab}	18.300^{ab}	0.4140^{a}	10.433^{cd}
V2*SR2*D2	27.500^{abc}	37.400^{bc}	15.067^{abc}	0.4538^{a}	8.673^{d}
V2*SR3*D1	19.900^{bc}	35.300^{bc}	15.300^{abc}	0.3716^{a}	12.800^{cd}
V2*SR3*D2	19.100^{c}	15.733^{c}	8.200^{c}	0.3609^{a}	6.433^{d}
L.S.D	14.174	23.570	8.870	0.1778	13.921

*V=Varieties' ,SR= Seed Rate ,D=dose fertilizer /L.S.D= Least significant different.

4.4 Number of branches/plant:

Number of branches was highly significant for varieties and significantly different for dose and interaction between varieties and seed rate, while the rest of the treatments resulted in non significant difference (Table1).Within varieties V1 gave highest value (18 branches), also gave (18 branches) and doses D1 had highest number of branches (18.5)(Table2).Interaction between treatments indicated that the highest number is 22.6 branch which revealed by (V1*SR3*D1) and lowest is 8.2 by (V2*SR3*D2) (Table 3).

4.5 Plant density/m^2:

The analysis of variance showed that significant effect of seed rate and varieties, and highly significant in interaction between varieties and seed rate (Table 1). V1 had higher plant density (19 plants/m^2) Seed rate SR2 (20plants/^{m2}) compared to other seed rates. Interaction between treatments indicated that the highest number is 30.7 recorded by (V1*SR2*D1) followed by(29.4) (V1*SR2*D2) and the lowest is 6.4 given by (V2*SR3*D2) (Table 3).

4.6 Forage fresh weight (kg/ha):

Analysis of variance of this parameter revealed highly significant difference of varieties and significant difference of seed rates (Table4). The interaction of the three factors (V1*SR2*D1) revealed highest productivity of fresh weight about 12000 kg/ha (Table5), while interaction between (V2*SR3*D1), (V2*SR3*D2)resulted in the lowest productivity (3.21)and(3.11) respectively (Table 6).

4.7 Forage dry weight (kg/ha):

The ANOVA table showed that there's a highly significant difference between the two varieties and also the three seed rates (Table4). Varieties, seed rate and doses interaction (V1*SR2*D1) revealed highest dry weight about(0.31kg/ha) (Table6).

Table (4) : Summary of the Analysis of Variance (ANOVA) fresh weight and dry weight of mung bean under Varieties, Seed rate:-

Source	Fresh Weight	Dry Weight
Replication	6.68^{**}	10.85^{***}
Varieties	15.78^{***}	22.54^{***}
SEED RATE	5.83^{**}	7.20^{**}
VAR*SR	0.38^{NS}	0.77^{NS}
DOSE	0.54^{NS}	0.42^{NS}
VAR*SR*D	0.11^{NS}	0.16^{NS}
TOTAL	7.4454	1.0685
C.V	41.24	41.40

NS= non significant, ** = statistically significant difference at p= 0.05

Table (5) : Mean comparison of parameters effects of yield parameters Studied fresh weight and dry weight of mung bean under Varities, Seed rate and Application time:-

Treatment	Fresh weight	Dry weight
Seed rate1	8.7175[a]	1.3043[a]
Seed rate2	8.6433[a]	1.2259[ab]
Seed rate 3	4.9754[b]	0.6754[b]
Varity 1	9.4781[a]	1.4187[a]
Varity2	5.4128[b]	0.7184[b]
Dose1	7.8225[a]	1.1161[a]
Dose2	7.0683[a]	1.0210[a]

The same letters in each column shows non- significant differences at 5% L.S.D.

Table (6) : Interaction effects of yield parameters Studied fresh weight and dry weight of mung bean under Varities, Seed rate and Application time

Treatment	Fresh weight	Dry weight
V1*SR1*D1	11.963^{ab}	1.7008^{ab}
V1*SR1*D2	9.330^{abc}	1.3950^{abc}
V1*SR2*D1	11.993 ^{a}	1.7958 ^{a}
V1*SR2*D2	10.600^{abc}	1.5892^{ab}
V1*SR3*D1	6.815^{abcd}	1.0188^{bcd}
V1*SR3*D2	6.767^{bcd}	1.0123^{bcd}
V2*SR1*D1	7.523^{abcd}	1.1280^{abc}
V2*SR1*D2	6.653^{bcd}	0.9933^{bcd}
V2*SR2*D1	6.030^{cd}	0.7416^{cd}
V2*SR2*D2	5.950 ^{cd}	0.7770^{cd}
V2*SR3*D1	3.210 ^{d}	0.3117 ^{d}
V2*SR3*D2	3.110 ^{d}	0.3590 ^{d}

V1=variety, SR =seed Rate, D=doses fertilizer

CHAPTER FIVE

DISCUSSION

There was highly significant difference of varieties on number of leaves per plant and significant difference on number of branches per plant .the local Variety recorded the best number of branches 51.20 and18.80 respectively. Variation in number of leaves per plant and number of branches of varieties might have occurred due to their differences in genetic make-up and phenotypic variation. This result in agreement with those of Kabir and Sarkar(2008).

Seed rates showed significant differences in plant height and plant density. The highest plant height was given at 6kg/ha(32.60), compared to other seed rates. This might be due to less competition between plants in this seed rate, this was supported by Ekanayke *et al*., (2011). The results of seed rates on the plant density (19.80). SR2 assures good crop stand, which ultimately lead to higher crop yield. Similar results were obtained by(,BARI,1997).

Doses of fertilizers showed significant difference on number of leaves and number of branches per plant. Number of leaves was influenced significantly by the application time of fertilizer; the highest values of number of leaves were found when fertilizer was added with sowing, while the lowest values of leaf number were observed from adding fertilizer after sowing. Number of branches was positively affected by the different application time. However, the maximum number of branches was recorded in application with sowing (18.5). The lowest value of number of branches(14.3)was recorded from application of DAP after a month. This was supported by Nadeem,(2004).

Varieties and seed rate interaction (V*SR)), had significant effect on number of branches per plant as well as on plant density. The local variety,planted at a seed rate of 6kg/ha gave the highest number of branches per plant. This might be due to the adaptability of the local variety. This was supported by (Uddin*et al* 2009). The lowest number of branches per plant and plant density were obtained in C24 variety at other seed rates.

Forage fresh and dry weight(kg/ha):

Varieties had highly significant effect on forage fresh weight, local variety produced 9.4781kg/ha compared with C24 (5.4128)kg/ha. Moreover, seed rate of(6 kg/ha) displayed significant difference; giving the highest value(8.8433)kg/ha . While least forage fresh weight at(10kg/ha) gave the lowest value(4.9754)kg/ha planting with appropriate planting density can help ensure optimum plant population per unit area of mung bean thereby increasing forage yield (BARI, 1998). Forage yield of mung bean was markedly influenced by planting density.

CONCLUSION

Mung bean should be sown under the different environmental condition and location, due to environmental variation.

Due to cost of production of animal protein have soared, mung bean may be introduced to produce seeds which have health benefits and rich source of protein ,vitamins and minerals.

This Experiment may be repeated, to confirm the current results

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