CHAPTER ONE
INTRODUCTI ON

Faba bean (*Vicia faba* L) a member of the family fabiaceae, also known as faba bean, field bean and horse beans, it's believed to be originated in Mediterranean region or in western or central Asia. It's one of the most important grain legumes in the world, grown on 3.6 million hectares in about 50 countries and the total grain production exceeded 4 million tons (FAO, 1981).

In the developing countries, most of the production is declined for animal feed. In many of the less developed regions of the world used primarily for human food. Some time it's harvested for green consumption as vegetable and in some part of the world the crop is still used as green manure.

It's an important food legume crop in Sudan. It's concentrated in Northern state north latitude 16N where environmental conditions are suitable for production better than other parts of the country. In this state more than 70% of the crop is produced in the Nile State ranks other parts of Sudan produced about 20% .Small amounts is produced in Khartoum state, central Sudan, Jabal Marra and kabkabia in Western Sudan .This crop is also an important source of income for farmer in Northern Sudan. It contributes to soil fertility through logical nitrogen fixation.

Faba bean is normally grown as a winter season crop in sub tropical region, with mild winter at high elevation under tropical condition, where the temperature is suitable its generally grown as spring season crop to avoid the period of sever frost(Kay 1979),and (Aageeb 1970), studied the effect of three irrigation interval in relation to two phases of plant development (vegetative and reproductive phases the

latter starting from pod set) of two faba bean cultivars on a heavy montmorilonlic clay soil. Their result indicated that the reproductive phase was more sensitive to water stress than the vegetative phase. Increasing the irrigation interval during the season from (7, 14 and 21) days reduced grain yield but application of the similar treatment during vegetative phase also decreased grain yield. (Mohamed *et al.*, 1980) studied the effect of the irrigation frequency in relation to the stage of plant development. Three watering interval (7, 10 and 14 days interval) were applied continuously or inter change in different combinations according to the phase of the plant development. The reproductive phase was supplied, followed by the vegetative phase but the late grain filling phase was least sensitive. It was suggested that, the best irrigation regime under Hudeiba conditions was 10 days interval during the vegetative stage and 7days interval during the reproductive stage. ((Mohamed *et al.*, 1980) found that the optimum seed rate for faba bean in the traditional growing area in Sudan appear to be round 120kg\ha. The recommendation, which came out of Hudeiba research station to plant the crop at spacing of (60X20) cm with (2-93) plant per hole or to use (70-120 kg/ha) seed /ha is adequate for obtaining a good seed yield,(Ageeb, 1982)Stated that drought stress has become the major limiting factor on plant growth and yield, when the full crop requirement are not. met Water stress deficit in the plant can develop to appoint where crop growth and yield are affected. Water deficit during the reproductive phase is considered to(have the most adverse effect on crop productivity (Chassemiet*, et al* ,2009) stated that drought is considered as one of the main limiting factor of more than25000000 ton lost each year, (Amedeet *et al* 2001) added that limited water viability to the crop can be due to physical and climatic factors ,the soil precision relation, the soil plant

relationship, excessive demand to the plant, or any concurrent with considerable negative effect on quantity of crop product.

The main objective of this study was to evaluate of the effect of water interval on growth and yield of faba bean at kabakabia.

CHAPTER TWO
LITERATURE REVIEWS

2-1 general:

Faba bean (*Vicia faba*) was cultivated by the Egyptian, Greeks and Romans in ancient Rome. They were used in funeral rites (food).

Faba were the only bean only known in Europe prior to veggies to the so-called, new world, and were a staple food during medieval time.

Central Asia. , Mediterranean, and south America are the centers of diversity.(Cubero 1974) postulated a near eastern center of origin, with four radii (1) to Europe (2)along the north African coast to Spain,(3) along the Nile to Ethiopia , and (4) from Mesopotamia to India. Secondary centers of diversity are postulated in Afghanistan and Ethiopia. however,(ladizinsky 1975b) reported the origin to be central Asia.

The wild progenitor and the exact origin of faba bean remain un known. Several wild species (v. *narbonensis* L.and V Galilaea plit man and Zohary)are taxonomically closely related to the cultivated crop ,but they contain 2n=14chromosomes, whereas cultivated faba bean has 2n=12chromosomes.Numerous attempts to cross the wild species to cultivated faba bean have failed (Bond *et al.,*1985).

The old seeds of vicia bean were found in Jericho and dated at 6250bc.The crops grown in the Mediterranean region where it is a common food in Europe, the faba bean is grown primarily as alive stock feed in Britain, where winter and spring type are grown ,the largest European producer of faba bean (Shulze *et.al*,. 2008))commercial production of faba bean in western India first occured in 1972 and since then the area under production is fluctuated.

Faba bean grown up right, ranging from 1 to 1.5 meter tall. It's an annual legume with one or more strong, hollow, erect stems. Faba bean has a strong tap root, compound leave and large, white flowers with dark purple markings. Flower cluster may produce one to four pods. The pods are large (up to 5- 10cm long and one to tow cm wide) and green, turning dark at maturity from brown to black color three to four along oval seeds are contained within each pods. Flowering occurs in 45-60 days and faba bean requires 110-130 days to mature.

Chinese broad bean (Vicia faba major) is produced in china, Europe, the Middle East, North Africa and South America. It is also be found grown in many vegetable, gardens in Canada. It has a1000 seed weight is 850 grams and is rarely contracted for growing in Saskatchewan .the seeding rate required is 325kg/ha and specialized seed drill required to accommodate, the large irregular shaped seed(Shulze e et.al, 2008).

2-1-1 Adaptation:

Faba bean is best adaptated to most agricultural areas and also best under relatively cool growing conditions, hot, dry spells will result in wilting of the plant and may reduce seed set. Faba bean should be grown with caution in the brown soil zones and droughty, light textured soil unless irrigation is available faba bean respond to irrigation. (Shulize *et al.,* 2008) showed best faba bean yield were obtained in cool and or wet locations.

Faba bean need cool season for best growth and are usually planted as winter annual in sub tropical or warm temperate areas. They can tolerate wide range of soils types and Ph, but grow best on deep soil. They need moderate amount of water .depending on growing conditions; it takes about four or five months for pods to mature (Zoharg and Hopt (2000).

Faba bean remained vegetative for 54 days and reproductive for 58 days the period of reproductive growth appeared to limit yield, indication that an earlier seeding date or earlier maturing cultivar may improve faba bean adaptability, faba bean should not grow on the same field more than once every four years. The legume crop increase the soil Borne disease (Shule 2008).

Faba bean is excellent nitrogen fixer and often dose not require extensive use of nitrogen fertilizer. Major beneficial of rotating pulse crop, such as faba bean ,with cereal crop is the interruption of best cycles most cereal disease do not affect pulse crops, soil born root rots in continuous cercal system may cause average yield losses up to 10 percent (Shulze 2008).

2-1-2 Biogeography:

Faba beans, one of the oldest domestically food legumes have bean cultivated for at least 5000 years. Their exact geographical origin is un known although central Asia and Mediterranean region have been proposed as possible centers', Existing wild species are similar in appearance to the cultivated plant ,but genetic analysis have shown that , the wild types have different number of chromosomes and, a fielded trial to cross , the wild and cultivated species have been unsuccessful,(Holden 2008).

2-1-3 Description of the crop:

Faba is an annual herbaceous plant with coarse hollow stems that can reach heights of two meters. It has Large pinnate leaves consisting of two to six leaflet itis, mainly pollinated by bumble bees, white flowers with purple markings form a clusters of one to five and one to four pods usually developed from each flower cluster, up to 30 cm in length Each

pod contains from three to twelve seeds. The plant also has three tap root up to one meter long with numerous astral roots(Zohary and Hopt, 2000).

Is also called fava bean, horse bean and bell bean, Faba is an erect leafy winter or summer annual. It grows to be bushy plant 2-7 branches and is in some genus as the vetches Unlike other vetches, its leaves do not have tendrils. The fruit is abroad leathery pod which is green and matures blackish –brown with densely downy surface and large seeded bean, Beans have 1-2 pods at each holed, while small seeded varieties produce 2-5 pods per node, which are up to 18 inches long and contain 3-12 Large beans there are about 15 pods per stalk on large types and 60pods on the small varieties. Pods vary in shape, size but should be picked when they are thick green and have glossy sheen. Faba bean can be used as winter or spring cover crop, green manure, silage, forage and vegetable .As vegetable, they are used either green or dried or fresh or canned, The faba bean can be dried and ground into flower which is commonly used in the middle eastern dish falafel. Seeds can be roasted and are eaten like peanuts in India(Wsuking, 2010).

2-1-4 Uses:

Faba bean is commonly eaten for breakfast in the middle east, the Mediterranean region ,China, Sudan and Ethiopia. They are used as soups and stews, and pester made of ground bean is deep fried with vegetable and spice (known as falafel in Lebanon). In India, the seeds are roasted and eaten like peanuts. Faba bean are also roasted and ground for use as coffee extender, Faba also used as a cover crop for animal forage the plants are large and produce amounts of biomass, that can be tilled back in to the soil as green manure , Straw from the plant is used in brix – making and as fuel in part of Sudan and Ethiopia (Hollen and Zohory,2008). Faba bean contain between 20% to 40% protein,

depending on the variety and the environmental condition under which most legume, were grown, the fiber is higher and fat is lower and good source of dietary fiber and B. complex vitamin, Faba bean can cause problems for small percentage of people, fauvism is an inherited condition in which person lacks an enzyme called glucose -6-phosphate dehydrogenate (G6pD). This rare deficiency occurs mostly among people of Mediterranean, Africa and South East Asian descent, the condition helps serve as defense against malaria by reducing the amount of oxygen in red blood cells .However, for people with fauvism, eating under cooked faba bean or breathing faba bean pollen can lead to a serious anemic condition, Faba beans are also higher than most beans in complex carbohydrates called oligosaccharides which may cause gas and abdominal pains(Hollen and Zohrg, 2008).

2-1-4-1 Poultry feed

Canada research has shown that diets for laying and growing turkeys containing 20 and 25 percent ground faba bean resulted in production for male romance equal to that form standard diets (Pillow, 2003).

2-1-4-2 Faba bean for cattle feed

In rations for dairy cattle, faba bean may replace soy bean or other protein meals except for coarse grinding, faba beans require no further processing can make up to 35 percent of dry soy bean

2-1-4-3 Concentrates:

Faba bean are an alternative to lupines in beef cattle feeding and are relatively safe to feed compared with cereal grains due to their lower starch levels, but it should be introduced to cattle slowly and with

caution, as with any grain to avoid the risk of poisoning due to a change in diet (Moore *et al* 2002).

2-2 Effect of water limitation on growth and grain filling of faba bean cultivars:

Drought stress has become the major limiting factor on plant growth and yield (Yardanov *et al,* 2000),when the full crop requirement are not met , water deficit in the plant can develop to apoint where crop growth and yield are affected., Water deficit during the reproductive growth is considered to have the most adverse effect on crop productivity (Baigorri 1999), and (Cuesta and France 2001), Over all, plant growth is a process of biomass accumulation, Karamanon and Gimenez 1991), and consequence of the interaction of photosynthesis, water relation and mineral nutrition processes,(Lambees, *et alt*, 1998) growth is the most important process to understand in predicting plant responses to environment (Hopkins 1995), plant dry matter production and accumulation can be analyzed through crop growth rate that are the most important growth indices,(Karimi and Siddige1991).

Faba bean (Vicia faba. L.) is a legume which has exhibited wide adaptability in world agriculture , the faba bean is regarded as drought sensitive crop,(Grasho 1990).

2-2-1 Plant water balance:

2-2-1-1 water deficit

Al though water in earths is most abundant compound, lack of water is the major factor limiting tolerance plant productivity on a global scale. Wide loses in crop yield from all other causes combined (Kramer 1980)

2-3 Water stress in plant

Drought or water stress is one of the major a biotic stress factors that effect all living organisms including human interest of the health and food. Water absence from the soil solutions affect the natural evaporative cycle between earth and atmosphere that contribute amount of irrigation. Drought occurs when soil moisture level and relative humidity in air is low while temperature is also high(UN report 2006), Water stress resulting from withholding of water, also change the physical environment from plant growth as well as crop physiology (Bernacchia *et al*., 2004). Drought, as an a biotic stress, is multitude signal in nature, and it affect plant at various levels of their organization in fact under prolonged drought, many plant will dehydrate and die (Youdanor *et al,* 2000).

2-3-1 Water stress why and how:

Plant experience water stress either when water supply to their root, becomes limited or when the transpiration rate, becomes internee, water stress is primarily caused by water deficit (drought or high soil salinity), In case of high soil salinity and also in other condition like flooding and low soil temperature, water exist in soil solution, but plant can not uptake it (Rao et.al 2006), a situation commonly known as physiological drought. Drought occurs in many part of the world every year. And frequently experienced in field grown plant under arid and semi -arid climates. Regions with adequate but non uniform precipitation also experience water limiting environment (Reddy *et al*,2004), since the dawn of agriculture mild to severe drought has been one of the major production limiting factors,(Shao et ,al , 2009). The general effects of drought on plant growth are fairly well known, However, the primary effect of water deficit at biochemical and molecular levels are not

considerable under stood yet and such under standing is crucial (Taiz, 2002), All plant have tolerance to water stress , but the extent varies from species to another. Knowledge of biochemical and molecular responses to drought is essential for a holistic perception of faba bean resistant mechanisms to water limited condition in higher Plants, (Warg *et al* 2003).

2-3-2 Morphological and anatomical changes:

In the majority of plant species water stress is linked to change in leaf anatomy and ultra structure, shrink eye in the size of the leaves (lowlor 2002), decrease in the number of stomata, thickening of leave cell walls, colonization of leave and under development of the conductive system increase in number of large vessels, submersion of Stomata in succulent plants and in xerophytes, formation of tube leaves in cereal and induction of early senescence are the other reported morphological changes (Nayyar et al, 2006).

The root to shoot ratio increases under water stress condition to facilitate water absorption and to maisnition osmotic pressure , although the root dry weight and length decrease as reported in some plants(Scala and Silicon 2009).

2-3-3 plant resistances to water stress:

Plant adapt themselves to drought conditions by physiological, biochemical, anatomical and morphological expressions, the whole plant level is highly complex and involves deleterious and for adaptive changes (Chao 2008). This complexity is due to some factors such as plant species and variety, the dynamics duration and intensity of soil water depletion, changes in water demand from the atmosphere environmental condition, as well as plant growth and phonological state in which water deficit is developed (Lannucci and Rasc 2000).

2-3-4 Plant to water stress:

Plant optimize the morphology, physiology and metabolism of their organs and cell in order to maximize productivity under the drought conditions. The reaction of plant to water stress differ significantly at various organizational levels depending upon intensity and duration of stress as will as plant species and its stage of development(Chao 2008). Water stress resistance in plant is divided in two categories, including stress tolerance and stress avoidance ,Drought avoidance is the ability of plant to maintain high tissues water potential under drought condition , while drought tolerance is a plant suitability to maintain it is normal faction even at it's low tissue water potential(, Warg *et a* 2003) .

2-4 Effect of water stress on plant growth and development:

Growth of plant is controlled by the role of cell division and by supply of organic and in or (ganic compounds required for the synthesis of new protoplasm and cell walls. Plant that suffer from water deficit often show reduction or cessation of growth, photosynthesis and respiration. However, water deficit can directly affect the increase in the size of plant or it's components through the action of turgor pressure in cell expansion. Cell division appear to be less severely affected than cell expansion but growth may be further inhibited by change in carbohydrate metabolism, nitrogen metabolism and possibly by the production of growth substance and translocation of material (.Banniste, 1976).

Effect of water stress on plant development is likely dependent on growth stage of the plant and is controlled by the rate of cell division and by supply of organic and inorganic compounds required for synthesis of new protoplasm and cell wall.(Helan *et a l*1989,, Elnadi 1970, and Ageeb 1976). They found that productive growth phase was more sensitive to water stress than the vegetative phase,(Heloblethwaiter *el al* 1982) reported that irrigation during the reproductive phase increased

plant height primarily by increasing the rate of cell division in the intercalary meristem of inter nodes meditated by the interaction of plant hormones such as ethylene and gibberellin acid thus plant develop more nodes and longer inter nodes under water stress.(Slayter, 1969 and(Hebolethwaile 1983) found that the reduction in relative increase in faba bean plant height during late flowering and early grain filling stages coincided with start of pods growth and the reduction in crop vegetative growth.

2-5 Vegetative phase

2-5-1 Plant height(cm)

Generally the number of nodes and internodes length determined the plant height of the crop and they were both affected by water stress.The reduction of plant height due water stress in faba bean was reported by,(Conover *et al* 1989).

2-5-2 Flower:

Water stress causes substantial reduction in crop productivity and the extent of damage depends upon the developmental stage of the crop, Itis there for important to determine the stage of plant deficit and irrigation scheduling for faba bean is often recommended to play particular attention to ,,moisture – sensitive period,, namely flowering,..(Elnadi 1969).Water stress during these phases greatly reduce yield and water stress during flower formation produced fewer flowers. (Ahmed 1989) found that water stress reduced the number of reproductive organ and flower intensity where as percentage of flower shedding was increased. The overall production of reproductive structures and their premature flower is recognized as adaptive strategy ensuring maximum fruit set due to adverse environmental condition.(Stephanson 1981).

2-5-3 Number of branches pr plant

In faba bean, bean number of branches depends on genotype and environment((Chrislian *et al* 1990 and Stent House, *et al*,(1997) reported that the number of productive branches in faba bean varies from 1-12 branches / plant. Generally, branching may be extensive sparse stand, particularly when good soil moisture is available. (Conover *et al* 1989).

2-6 Productive phase:

2-6-1 Pod production:

In faba bean (Salem, *et al* 1983 and Ahmed 1989) reported that pod production decreased and percentage of pods abscission increased during water stress. Research findings revealed that faba bean is less sensitive to water shortage in pre flowering than post flowering period (Farh and Ageeb 1985), However the most important period for water demand was shown to be at flowering to pods filling(Aawadros, 1986) Stress applied during pods filling for pods formation resulted in greater yield reduction than stress applied during flowering (Sionit and Kaeamer(1977),. They stated that during pods filling water stress resulted in reduced seed size but with no effect on number of pods or total number of seed per pod.

2-6-2 Number of days to physiological maturity

In faba bean maturity period vary depending on the cultivars', hybrid and climatic condition (Dewey *et al* ,2004) reported that plant reaches physiological maturity stage of maximum total dry weight 75-85 days after emergence, growth and maturation are usually hastened with later plantings.

2-6--3 Number of seed per pod:

For any given cultivar of faba bean ,the average number of seeds per pod is relatively stable character , but usually ranges from less than two in certain cultivar to about eight in others(Chapman, 1981). In faba bean, frequent irrigation at 7 days interval significantly increased seed number per pod where as, water stress greatly reduced the formation of fruiting pods.

2-6-4 100 seed weight

Water stress during seed filling stage reduced 100 seed weight of faba bean as reported by (Salih, 1985) who showed that increasing water interval stress decreased the 100 seed weight of faba bean. Varieties were found to vary from 37.8 - 56.7g(Salih, et al1983), found that 100 seed weight remained un affected by increasing irrigation. The difference in grain size was attributed to supply of assimilate from current photosynthesis or the ability of plant in translocation of the dry matter to growing grains.

2-6-5 Seed yield:

The retaliation of reproductive sink potential in green legumes is limited to 10- 30% to cause premature abscission of reproductive structures which is one of several critical physiological traits determining harvestable (Signh 1977)., Water stress during pods filling of faba bean showed that increasing water interval decreased the seed yield (Shows, 1992). Drought during flowering stage reduced yield by 44% and pod number by 49% and plant maturity by 10 days earily compared to non stress plant (Salih 1988).

Faba bean, irrigated every 7 days significantly increase seed yield and number of pods per plant . (Salih, 1985),obtained seed yield of 4.013 and 2.408 ton / ha when plant were watered at 7 or 14 days intervals

respectively, However ,irrigation at growth pods stages gave the highest average grain yield (Singh *et al*, 1987).

2-6-6 Number of days to 50% flowerings:

Faba bean usually flowers in 40 to 55 days from emergence depending on the cultivar hybrid and climatic condition,(Dewey *et al* 2004) the flowering structure inflorescence is called flowers. Depending on variety or hybrid, the flowers begin to open in 2 to 3days after emergence of flower. It takes 10- 20 days to complete flowering depending on the branching habits and production environment (Anon,1984) reported, that the water stress delayed flowering of faba bean, with effect being more pronounced on branches.

CHAPTER THREE
MATERIALS AND METHODS

3-1 Location:

A field experiment was conducted for one season 2012/2013 in the demonstration farm in kabakbia city in North Darfur State, Western Sudan. Its situated at altitude 13-21N and longitude 24-5 E it's about 1200km south west of Khartoum and at an elevation of approximately 760m above the sea level. The climate is semi arid with an annual rainfall, between 200-500mm

3-1-1 Source of seed:

The mateial consisted of five faba bean varieties namely, Hudeiba Eddamer, S. M. L., Basabeer from (Hudeila ARC) and Baladi (Kabakabia) local variety.

3-1-2 The layout of the experiment:

3-1-2-1 Land preparation

The land was prepared by disc plough, harrowing, leveling and ridging, spacing between ridges and holes were 70 cm and 30cm respectively, the size of sub plot was 3.5X2.1 M consisting of six ridges s ,In each sub plots, the two meter outer ridges were used for growth sampling and middle two ridges were used for yield determination

3-1-2-2 Experiment design

The experiment was arranged in a factorial 3X5 split plots design (RCBD) with three replications the main plots were allotted to water intervals and sub plots for the treatments.

Where as follows:

W1= plants were irrigated every week (7 days)

W2= plants were irrigated every two weeks (14 days)

W3 = plant were irrigated every three weeks, (21 days).

3-2-3 Husbandry

Sowing was done at a rate of two seeds / hole, the sowing was on the 16th of November, the crop irrigated every week during the first month, two hand weeding, insects was kept under control by sprayings with malthon 57%.

3-3 Characters studied:

Five plants were randomly selected and tagged in each sub plot to measure the flowing growth attributes. Just before the start of flowering the experimented field was visited daily to determine the following phonological attributes.

3-3-1 Mean plant height (cm):

The plant was measured from the base of the mainstem to the tip of youngest leaf using metric tape.

3-3-2 Number of branches / plant:

The number of branch per plant was determined by counting all branches in the tagged plant and the mean number of branches was calculated.

3-3--3 Number of leaves / plant:

The number of green lea**3-**

The number of green leaves was counted in all tagged plant and the average mean number of leaves / plant was determined.

3-3-4 Number of days to 50% flowering:

The tagged plants observed from sowing to 50% plant flowering were visited every other day and all plant that had emerged since the previous days were counted from this date, the mean number of flowers per plant was determined for each treatment

3-3-5 Number of days to physiological maturity 95%:

The tagged plants were counted daily to determine the average maturity day.

Five plant were randomly selected from the second ridge or either side of plot tagged to study the flowing parameters

3-3-6 Number of pods / plant:

Pods produced in tagged plant were counted daily to determine the mean number of pods per plant.

At harvest, pods in tagged plant were counted to determine the mean of harvested pods / plant.

3-3-7 Number of seeds per pods:

At harvest, pod in tagged plant were counted then threshed manually to determine the average number of seed per plant.

3-3-8 100 seed weight (Gm):

The weight of 100 seed was determined by weighting replicate samples of 100 faba bean grains obtained form each plot using trible balance.

3-3-9 Grain yield per plant (Gm):

At harvest, pods in tagged plant were threshed mainly, the seed were then weighted and seed yield per pod were determined.

3-3-10 Grain yield / kg / ha:

Plant was taken from one meter square from inner two ridges were harvested and left to dry pods recovered from plant were manually threshed , the seed were weighted and seed yield (Kg/ ha) was estimated.

3-4 Statistical analysis

Analysis of variance (ANOVA) appropriate for split plot trial was used according to(Gomeza and Gomez, 1984) and means significance differences (LSD) for the different characters. Were calculated using SAS.

CHAPTER FOUR

RESULTS

4-1 Number of days to 50% flowering:

The statistical analysis table (1) showed significant difference between varieties for 50% flowering days to under different treatment.

The earliest one is (43) days under regime w_2 recorded by Hudeiba93. The last one respectively (45.66) by Baladi and S. M. L. under treatment w_1 and w_2.(table 2)

4-2 Plant height:

The statistical analysis. Table (1) showed non significant differences between varieties for height under the different treatment. Appendix (1).

The highest plant (92.53cm) under regime $w_3$was recorded by S. M. L.

The lowest (79.26) plant height was obtained by Eddamer under treatment w_1. (table2)

4-3 Number of branches per plant:

The statistical analysis (table 1) revealed non significant difference among the five varieties of faba bean under different treatment.

On the hand the effect of water regime on number of branches showed that Eddamer had higher number of branches (4) under treatment w_2

Continued (table 2).

The lowest number of branches was obtained by Eddamer also under treatment w_1 (1.93).

4--4 Number of days to 95% physiological maturity:

The statistical analysis revealed non significant difference between varieties for maturity 95% days under different treatments. The earliest

one (89.66) day under regime w_3 recorded by S. M. L. the last one (98.66) days under regime w_1 recorded by S. M. L. also continued (Table 2).

4-5 100 seed weight (g):

The statistical analysis table (1) showed significant difference between varieties for 100 seed weight under different treatment.

The higher one achieved by Baladi under treatment w_1 (75) and the lowest one obtained by Eddamer (36.47) under treatment w continued (Table 2).

4-6 Grain yield (Ton/ha):

The statistical analysis table (1) showed significant difference between varieties for grain yield under different treatment.

The higher grain yield (3.74) ton/ha under regime w_1 recorded by Eddamer. The lowest grain yield was obtained by Baladi (1.25) under treatment w_3. Continued (Table 2).

Table (1): Mean effect of five of varieties on growth and yield attributes of faba bean

Varity	50%flowring days	Plant height cm	Number of branches /plant	95% maturity days	100 seed weight	Grain yield ton/ha	Biomass ton/ha	Number of pods/plant
Hudeiba 93	43.66B	89.50A	3.35A	94.77A	40.93 C	2.30 A	5.73A	24.28A
Basabeer	43.55B	86.35A	2.86A	94.55A	40.60 C	2.18 B	5.42A	15.46B
S,M.L	45,22A	88.46A	3.ooA	94.66A	52.95 B	1.57 C	4.9A	11.68B
Eddamer	45.55A	83.80A	3.00A	96.33A	38.12 C	2.37 A	5.2A	23.46A
Baladi	45.22A	88.70A	2.89A	94.66A	61.36 A	1.73 C	5.97A	15.55B
Mean	44.69	87.36	3.02	95	46.79	2.03	5.46	18.09
SE	0.81	4.02	0.41	0.73	3.02	0.301	0.781	2.52
C,V	3.17	7.97	24.77s	2.46	11.21	26.17	24.75	24.07

Means in same column followed by same letter are not significantly different at 0,05 probability level using Duncan's Multiple Range Test

Table (2): Continued

Variety	Number of branches				Variety	Maturity da		
	W1	W2	W3	Mean		W1	W2	
Hudeiba 93	2.66	3.7	3.66	3.35 A	**Hudeiba 93**	97.66	94	
Basabeer	2.66	2.4	3.53	2.86 A	**Basabeer**	98.33	95	
S,M,L	2.86	3.26	2.86	3 A	**S,M,L**	98.66	95.66	
Eddamer	1.93	4	3.06	2.89A	**Eddamer**	96.33	97.3	
Baladi	2.53	3.06	3.06	2.89	**Baladi**	95.3	95.66	
Mean	**3.02**				**Mean**			**95**
SE	**0.41**				**SE**			**0.73**
C.V	**24.77** A				**C.V**			**2.46**

W1: watering every 7days - **W2**:watering every 14 days - **W3**: watering every 21 days

4-7 Biomass yield (Ton/ha):

The statistical analysis (table1) showed non significant differences between varieties. The highest value of Biomass is (10.49) under regime w_1 recorded by Baladi. The lowest value recorded by Baladi also under treatment w_3 (1.53) biomass yield. Continued (table 2)

4-8 Number of pods per plant:

The statistical analysis (Table 1) showed significant difference at $p \leq 0.5$ between varieties for number of pods per plant.

The highest number of pods (28.73) under regime w_2 recorded by Eddamer. The lowest was obtained by S. M. L. (10.66) under regime w_1 continued (Table 2).

Table (2): Continued

Variety	Biomass				variety	Number of pods			
	W1	W2	W3	Mean		W1	W2	W3	mean
Hudeiba 93	7.86	5.49	3.86	5.73A	**Hudeiba 93**	17.9	35	20	24.28 A
Basabeer	6.69	5.45	3.24	5.42 A	**Basabeer**	11.6	13.33	21.46	15.46 B
S,M,L	7.17	5.5	2.15	4.9 A	**S,M,L**	10.66	13	11.4	11.68 B
Eddamer	6.83	5.61	3.18	5.2 A	**Eddamer**	22	28.73	19.66	23.46 A
Baladi	10.49	5.81	1.53	5.97 A	**Baladi**	12.86	22.26	14.86	15.55 B
Mean	**5.46**				**Mean**	**18.09**			
SE	**2.52**				**SE**	**2.52**			
C.V	**24.07**				**C.V**	**24.07**			

Table (2): Interaction effect of variety and water levels on growth and yield attributes of faba bean

Variety	50% Flowering days				variety	Plant height		
	W1	W2	W3	Mean		W1	W2	
Hudeiba 93	43.3	43	44.66	43.66 B	**Hudeiba 93**	89.9	88.6	
Basabeer	43.66	42.66	44.33	43.5 5 B	**Basabeer**	80.86	89.53	
S,M,L	45.66	45.66	44.33	45.22 A	**S,M,L**	84.76	88.2	
Eddamer	45.33	45.33	46	45.55A	**Eddamer**	79.26	88.9	
Baladi	45.66	45.66	45	45.22 A	**Baladi**	84.2	89.46	
Mean	**44.69**				**Mean**	**87.36**		
SE	**0.81**				**SE**	**4.02**		
C.V	**3.17**				**C.V**	**7.27**		

Table (2): Continued

Variety	100 seed weight				variety	Green yie		
	W1	W2	W3	Mean		W1	W2	
Hudeiba 93	38.46	42.30	38.69	40.93 C	**Hudeiba 93**	3.10	2.49	
Basabeer	39.92	41.57	36.51	40.60 C	**Basabeer**	2.22	3.07	
S,M,L	52.23	49.22	47.31	52.95 B	**S,M,L**	2.38	1.8	
Eddamer	36.7	37.78	36.47	38.12C	**Eddamer**	3.74	2.96	
Baladi	75	54.26	64.44	61.36 A	**Baladi**	3.36	1.88	
Mean	**46.79**				**Mean**	**2.03**		
SE	**3.02**				**SE**	**0.301**		
C.V	**11.21**				**C.V**	**2617**		

CHAPTER FIVE

DISCUSSIONS

Water stress affects practically every aspect of plant growth, for example leaf expansion and stem elongation inhibited by drought considerably earlier and more severely than processes such us photosynthesis and respiration. Considerable reduction in faba bean growth attributes under water limiting conditions, has bean reported by many researcher (Elnadi, 1969, Kramer 1969 and Ahmed 1989). This might explain the consistent reduction in plant height, pods number per plant, seed weight under water stress.

This study showed non significant effects of water stress on plant height. However, this investigation disagree with results obtained by (Hebblethwaite *et al*., 1983) and (Ahmed, 1989) who stated that watering increases plant height primarily because plant develops more nodes and longer internodes. However, (Ishag, 1973) and (Ahmed, 1989) attributed the later reduction in plant height under water stress to translocation of assimilates to the reproduction sink. In this investigation, prolonging of watering interval not significantly reduced the number of day to start of flowering ,50% flowering and days to 95% maturity of faba bean plant .this result was supported by (Mahala and Bidinger, 1986). They showed that severe water deficit during the period of pods development delays flowering. In contrast, (Anon, 1984) reported that flowering of faba bean plant was delayed by water stress in both pods and branches with effect being more pronounced in branches. Similar findings was reported by (Bidinger *et al.,* 1988) who found that faba bean cultivars have development plasticity under drought condition by delaying flowering and simulation of secondary branch growth. (Dewey *et al*., 2004). Showed similar finding that the mean number of pods per plant decreased

with increasing water interval where number of abscessed pods slightly lower in well watered plants. Similar results ware reported by (Salem *et al*., 1983 and Ahmed 1989).This might be due the translocation of assimilate to pods and seeds at the expense of the vegetative growth (Isahg, 1973).Under water stress conditions the reduction in number of mature pods under water stress apparently resulted from reduction in sink size into pods, (Ravendra, *et al*., 1990).in current study, water stress had no significant effects on mean number of pods and 100 seed weight. Similar finding were reported by (Krogman *et al*., 1980) and (Samia, 1997) who stated that for any given cultivar of faba bean, the average number of pods per plant is relatively stable character. Similarly (Farah, 1981) added that the number of pods per plant proved to be the most consistent component of yield under water stress. In this study seed weight also was non significantly receded under water stress treatment due to lower number of pods per plant which disagree with (Salih, 1985) who attributed the reduction in seed yield under less frequent watering interval to the reduction in number of pods per plant. On other hand (Mohan, *et al.,* 1982) attributed the reduction in seed yield under water stress to the depressive effect of soil moisture on plant stand and on the number of pods per stem which agree with result (Samia 1997). However (Turk and Hall 1983) stated that, seed yield under water stress is limited by the source of reproductive sink. Significant variation in seed yield was observed among the tested verities and between water treatments. Variety Eddamer produced higher seed yield compared to other verities whereas the lowest seed yield was obtained by S.M.L. The variation in seed yield among the verities could be attributed to difference in number of pods per plant and growth habit. In addition to their responses to water stress that may be genetically in nature, (Amede 1998), reported that grain in beans in the product of number of plant or fruitfull axis per plant unit area,

(Hisa and Acelevado, 1974) attributed to the reduction in seed size to decrease in dry matter translocation, as a result of reduced source and sink stress . The rate of dry matter translocation, to the seed may have also been stopped under stress causing significant reduction in total seeds weight. (Salih, 1985) similarly (Singh *et al*., 1987) showed that the number of seed per pod was generally lower than with irrigation at mid pod filling stage. In contrast seeds were unaffected by irrigation, number of pods per plant or number of seed per pods and 100 seed weight. Drought at the bingeing of growing at the seedling stage is very detrimental. At flowering drought is known to cause abortion of flowers through assimilate shorter resulting in yield reduction (Stocker, 1979), pointed out that the major component of yield affected by drought were the number of pods per plant. Water stress used in this study was expected to cause reduction in seed yield. (Link *et al*, 1999) report that no significant differences among the plant height and grain yield per plant, although it was noticed that Hudeiba93 attained highest mean of plant height with no significant differences. This results is in confirm with (S. Ganupathy 2011) who showed wide range of variation and no significant differences for all characters under study. High reduction of yield was observed when the drought was at vegetative stage. This can be attributed to low leaf number, which may lead to low leaf area photosynthetic ability, (Eltony 1998), and for low biomass accumulation during the vegetative stage, or may be due to the small translocation rate as the plants were stressed at seed filling. This was in agreement with (Tulu *et al.,*1998) and (Classen *et al.,*1970), Moreover, stress at vegetative stage, particularly at flowering stage, reduced faba bean seed yield and this is due to low number of seed per plant. These findings were in line with the finding, of (Claossen and Show 1970) and (Song *et al*., 2000) that water

stress at the pre- filling pods period was found to be important for both development of vegetative and reproductive structure.

The reduction of number of pods per plant or branches, grain weight/ meter, 100seed weight was during the drought at vegetative stage until to end of flowering. This may be due the fact that stress at growth and development of female inflorescence has great yield reduction. This fact indicated that stress at this period at any location tended to produce increase in great effect, because this period is very critical to stress water. (Bolenos and Edmedes, 1993).The results indicated that the reproductive characters were more significantly affected by water regime in value than the growth characters.

CHAPTER SIX

Summary and conclusion

1-The results indicated that water significantly reduced plant height number of pods per plant and number of branches per plant

2-Prolonging of water interval significantly reduced the number of days to flowering and maturity of faba bean.

3-Thr results showed that, among all measured vegetative attributes, water interval hat only significantly effect on mean grain yield and 100 seed weight.

4- At achieve the best growth and grain yield it is recommended to irrigate faba bean variety every 7 to 14 days.

5- Variety Eddamer is the best one and height resistant of drought.

REFERENCES

Ageeb O.A, 1976 chinch pea fertilize , watering interval and plant spacing Ann., Rep. of Hudeida ARC stat 1975 – 1976, 3-5 Eldamer-Sudan.

Ageeb (1977). Efect of watering intervals and sowing date on plant survival and grain yield of faba beans. Annual Reports, HRS. Sudan.

A. lannucci, A. Rascio, M. Russo, N. Difonzo and Maritinello, (2000) Physiological responses to water stress following according period in berseen clover) plant and soil vol 223, p.219.229.

Al- Ghandi S. S. And Al tahir o. A. (2001) Temperature and solar relatio effects on faba bean growth and green yield sauidi boil sci 8- 171- 182

Bairgoriih H and Costa France journal of food agriculture and environment vol.7(384): 442-44-2009., faculty of agriculture university of Tabriz Iran .

Amede, T. K., Paul, R., Wilson, L., Lumbagos, K., Hassa, D., Irongo and M. Nkoko (2001). Strategies to improve genetic adaptaion of common bean to Drought Prone Regions of Africa. Working Group Synthesis. 30-31 September. Nairobi, Kenya.

A. R. Reddy, V. R Reddy and V. Anbumozhi (2003). Physiological responses of ground nut (*A rachis hypogeal* L) to drought stress and its amelioration critical review. Plant growth regulation vol.41, pp 75.88. E. Sacala, role of silicon in plant resistance to water stress.

Ahmed M. E. M. (1989) response of faba beans (vicia faba l.) to water an heat stress Msc thesis faculty of agriculture, University of Khartoum.

Baigorri, H., Antolini, M. C. and Sanchez-Diaz, M. 1999. Reproductive response of two morphologically different pea cultivars to drought Eur. J. Agron. 10: 119-128.

Bannister, P. (1976). Introduction to physiological plant ecology. Black Well Scientific Publicants. London Edinburg Melbourne.

Capman. G. P. (1981). Genetic variation wit hin *Vicia faba* L.. FABIS new letter No. 3 supp1- pp 1-12.

Bidinger F.R.ludlow .M,M and Muchow ,R.C 34 (1988) critical evaluation of the possibilities for modifying crop for high production per unit of precipitation in drought research priorities for the dry land tropics patanchera India :ICRISAT,179-211

Bolanos, J and G.o .Edmeades (1983)eight cycle of selection for drought tolerance in lowland atropines in reproductive behavior filed crops Res -31:253:268.

Bond D.A,DA lawes ,G.C Hawita ,M.C.Saxenena, and J,S Stepherns (1985), faba bean (vicia faba L).p.199-262- in R.j summer field and E.H.Roberts grain legume crops Willian Collins co ltd & Grafton street London wax 31 AUK.

Biginger F. R. (1989) flowering response of pear millet to water stress during panicle development ,international crops research institute for semiarid tropes (ICRISAT) Patancheru po.502.324 India.

Buckel, S., Herrnodson, M. A., Pfankoch, E., Regnier, F. E. and Bressan, R A. (1987) Characterization of osmotin. Plant Physiol., 85: 529- 536.

Conover , D.G. and Sovrick D.A, A(.1989),influence of water deficit on water relaxation and growth of Echinochia turning, Echinochia curs- gall, and pennisetum americium. Plant physiology, 16 (3) 291-304.

Chapman G.P,(1981) genetic variation with vicia faba new letter , No.3 supp-pp1-12.

Chasseni et ,at,(2009) journal of food agriculture and environment vol.7. (364) = 442-447,

Chernyadad , E,V ,(2005) ,effect of water stress on the photosynthesis apparatus of plant and the protective role of cytokines . Are view, applied biochemistry and Microbiology vol.41.pp.115-128.

Chrisitanson C. B . Bartiono , Ahernao, J and velek. p.l.G 1995, fate and efficiency of N fertilizer applied to millet in Niger plant and soil 125-221-231.

Claudio Costa, L., Morison, J. and Dennett, M. 1997: Effects of water stress on photosynthesis, respiration and growth of faba bean (*Vicia faba* L.) growing under field conditions. Revista Brasileira de Agrometeorologia 5:9-16.

Costa-Franca, M.G, Thi, AT, Pimental, c, Pereyra, R.O., ZuilylFodil, Y. and Laffray, D. 2000. Differences in growth and water relations among *Phaseolus vulgaris* cultivars in response to induced droughtstress. Environ. Exp. Bot. 43:227-237.

Culero j(.1974) evolutionary trend in vicia faba theoretical and applied genetics 43:59-65.

Cubero, J. I. (1974). On the evolution of *Vicia faba* L.. Theor. Appl. Genet. 45, 47- 51 in: The faba bean (*Vicia faba* L.). First published (1983) p4 (Hebbleth waite, P. D.). University of Nottingham Scool of Agriculture London.

Classen ,M.M.and R.h Show (1970)water deficit effect on corn 11 grain components agricu j.62:652-655.

Dewey le. Wayence H.G, David B. William D. Patricia , T, and Jehrey, P.W,(2004), pearl millet for grain.

ELtony, E. M. A. (1998) growth and yield of maize as in flounced by water stress at different growth stage M. sc. thesis. Faculty of Agriculture university of Khartoum .

ELnadi A. H. (1969) water relation of beans II. Effect of water stress on growth and flowering exp. agric 5.195.207.

ELnadi (1970) water relation beans II, effect of differential irrigatio.

E. Sacala, "Role of silicon in plant resistance to water stress," *Journal of Elementology*, vol. 14, pp. 619-630, Sep 2009.

on yield and seed size of broad beans Expl agric 6(No,.2) 107-iii.

FAO (1981). Production year book, Vol. 35, 1981 FAO, Rome.

Farh S, M. (1981). An examination of effect of water stress on leaf growth of crop of filed bean (vicia faba L) 1-crop growth and yield j agric sci camb 96.:327-336.

Gomez k.A and Gomez A. A(1984)statistical procedures for agricultural research, 2nd edition A wily Inter Sci . publication John wiley and son, New York.

Hall, at.et..J.CLOSE AND E.A , Bray (1993),is dehydration tolerance relevant to genotypic differences in leaf essence and crop adaptation to dry environments ,Rockville ,Maryland : the American soc: plant pathologists.

H. B. Shaol. l. y. Chu, C.A. Jaleel and C.X..Chao (2008), water deficit stress induced anatomical changes in higher plants. Competes Rend us Biology, vol. 33, pp. 215-225.

H-B Sshao l.y .chu.c.A.JALEAL ,P.Manivannan, Panncerslyan and M, A Shao (2009), understanding water deficit stress induced changes in basic metabolism of higher plants – biotechnologically and sustainably improving agriculture and the eco environment in

arid regions of the globe ,critical revises in Biotechnology vol 29.131-151.

Hebble thwaite P.D.R.K Scott and J.O.S K Ogbe (1983) the effect of irrigation and bees on the yield and yield compo ants of (vicia faba) vicia faba agronomy , physiology and breeding (ISBN) 90-247-296b-17-91

Holden , k. faba beans levodopa and Parkinson's disease (2008)ARC. Centre of excellence for integrative legume research is partner ships of the university of queen stamina Australia the university of new case.

Hopkin W. G. (1995) introduction of plant physiology , john wily and Sons Canada

Hisiao T.C. and E.Acevedo .(1974), plant response to water deficits water use efficiency and drought resistance . Agricultural Meteorology 14.59-89.

H. Riemer, and D. Stelling (1999) genotypic variation for drought tolerance in vicia fabaL plant breeding 118:477-483.

Ishag , H. M. (1973) Physiology of seed Yield in field beans (*Vicia faba* L) yield and yield component.J Agri Sci crumb 80-181..189.

Krarner, P. J. 1980. Drought, stress, and origin of adaptations. Pages 7-20 in N. C. Turner and P. J. Kramer, eds. Adaptation of Plants to Water and High Temperature Stress. John Wiley & Sons, New York.

Karamanos A , J . And Gimenez(1991), physiological factors limiting growth yield of faba bean. pitons Mediterranean's 10-79.-90.s

Karimi M M and siddique k.H M (1991) crop growth relative growth rate of old modern wheat cultivar Aust . J Agric . Res42.13.20,

Kay D.E(1979) broad beans in food legumes tpi , crop and product

digest No. 3.26.47.

Kramer R.K (1969) plant and soil relations ship . A modern synthesis.

K.,V. M. Rao, A. S. Raghavedra and k. J Reddy Eds.(2006) Physiology and Molecular Biology of stress tolerance in plant.Dordrecht..Springer

A.Rreddy, k. V. Chaitanya and M. vive kanandan , drought in deuced responses of photosynthesis and antioxidants metolism in higher plant journal of plant physiology vol.161,pp . 1189-1202, (2003). Journal of element ology . vol 14.pp , 619-630,sep 2009

Krogman k. k. and Mchenize R.Cand hobbs ,E.H(1980) response of faba bean yield protein production and water use to irrigation –car j plant sci,60:91-96.

K. Shinozaki and K. Yamaguchi-shinozaki (2000)molecular response to dehydration and low temperature differences and cross – talk between two stress signaling path ways, currant opinion in plant Biology Vol 3-pp217-223

Ladizinski, G. (1975). On the origin of the broad bean, *Vicia faba* L. Candian, J. Bot. 24, 80- 88.

Lambers H. chupin F. S . and pons fl 1998) plant physiological ecology Springer verlag New york.

Link, w. A .A Abdelmula, E.Von Kittlist, s. Bruns, Riemer and D. Stelling, (1999) genotypic variation for drought to lerance in vicia faba L plant breeding 118:477.983.

M. A. Jenks and G,M. Hasegowa . plant argotic stress chic ester . John Wiley and sons(2007).

M. Ashraaf, Ashlag and M.Y. Ashraf effects of increased supply of potassium on growth and nutrient content in pear millet plant Aram, vol.45.pp 141-144, 2002.

Mohamed, A. B. A., (1980). Effect of fertilization and irrigation on wheat (*Triticum aestivum*) growth in salt affected soils. M. Sc. Thesis, University of Khartoum.

Mohan, C. S., Sarena, A. D., Richard, T and Steward, R. A. (1982). Faba bean in Nile valle. Report on the first phase of the ICARDA/ IFAD Nile valley project (1979- 1982).

M.M Chaues J.S. Pereira J. Maroco .Ml Rodrigues C p.p Ricardo, Ml Osorio,I, Carvalho, T.Faria and C. Pinherior, how plant cope with water stress in the field photosynthesis and growth annals of botany vol .89.pp 907-916-2002.

Nagarajan, S. and NagarajanS. (2010). Abiotic stress adaptation in plant physiological molecular and genomic foundation (eds – Pareek , A. Sopory , S.K , Bonner ,H,I. Govindjee pp.1.i11 Springer the Netherlands).

Nayyar and D Gupta ,(2006) differential sensitivity of C3 and C4 plant to water deficit stress association with oxidative stress and antioxidants. environmental and experimental botany. vol 58., pp.106-113

Ravendra V, Nautiyal ,R.C and Josh.,Y,C.(1990) physiological analysis of drought resistance and yield ground nut (A rachis hypogeal L trinndida) crop agric vol 67.N04.

Salem S. A., K Carsar and M. Bartels (1983)field studies on the irrigation levels and cultivars in faba beans in north Egypt J Agronomy and crop science 125-325-335,

Michal Digand, NSW agriculture Wagga, Wagga November 2003 iss0725-7759 .

Salih, F. A.1985 varietal performance of faba been under two different watering intervals FABIS New letter 30,16-19, options

Salih, S. H., Ali. A. E., and Khalafalla (1983). Report on back- up research faba bean breeding (1982/ 1983). A. R. C., Sudan.

Samia O.Y 1997 effect of phosphorus and sulphur application on Mycorhial and growth of bean vicia faba Lender two faba watering regime M. Sc. thesis university of Khartoum.

Saleem, M. (1988) In flounce of temperature , moisture ,and nitrogen on till ring of sorghum and pearl millet dissertation abs- international – B-sei, and Engineering 47:5,144.B.

S. Cherian M. Reddy and Rferreira, (2006) transgenic plants with improved dehydration stress tolerance progress and future progress and future prospects biological plant arumvol 50.pp.481-495.

Shulze , R. H. Saskatchewan agriculture Authore(s) E.D Robichaux, J.Grace, P. W. Rundel (2008). Agriculture knowledge center 1-866-457-2377 Holdem , k,2(2012) canopy temperature and crop water stress p.43-8.

Singh, C. (1977). Response of pigeon pea to water stress. Indiant J. Agric. Sci. 57- (1)- 29- 35.

Singh, S. P., Singh, N. P. and Pandey, R. K. (1987). Irrigation studies in faba bean 1983. FABIS News Letter 18, p 24- 24.

Singh, D. P., Singh, P., Sarma, H. C., and Turner, N. C., (1987). Influence of water deficits on the water relations canopy gas exchange and yield of chich pea (*Cicer arietinum*). Field crop research 16 (30 231-241).

Slerphenson, A.G. (1981) flower and fruit abscission proximity cause and ultimate functions, A annual review of ecology and systernatics 12:53-279

Song Feng and Bin(2000)effect of drought stress on growth and development of female in the rescinded and yield of maize journal of Chillan agriculture university (2000).

Stocker . R.(1979)-effect of water stress at different phases of growth of dwarf bean journal of experimental agriculture 2(1) 13-15.

Taiz and Ezeiger(2002) plant physiology's Sunderland, Mass .Sinauar Associates ,

W-Warg, B.Vinocur , A.Altman, plant responses to drought salinity and entrance temperatures towards genetic engineering for stress plant vol.218pp 1-14, 2003.

Turner, N.C and P, j.. Kramer (1980)adaption of plant to water and high temperature stress john Wiely and son .New york.

Tulu,I- and B.K Ramachandrappa (1998) combining ability of some taints in sever parents dialect cross of selection maize (zea mays L.) reputation crop water hear 15.232-237.

UN. Human development report (2006) Beyond scarcity Power, poverty and the globed water crisis accessed 8 august 2011

W. Lowlor ,(2002) limitation to photosynthesis in water stressed leaves stomata vs. metabolism and the role of ATP annals of botany avol 89, pp-871-885 .

Yardanov, V, Velikova and T. Tsoney,(2000) plant responses to drought .acclimation ,and stress tolerance photosynthesis vol- 38.pp.171-186 ,

Zohary , D. and Hopt , 2008 domestically of plant in the old world the origin and spread of cultivated plant in west Africa , Europe and Nile volley. oxford university press inc, new York.