



Research paper

**Evaluation of the Life Cycle of Two Wild Plant  
Species; Senna (*Cassia italica* Mill.) and Handal  
(*Citrullus colocynthis* L.)**

Osman El Bousairi Mohammed and Abdel Rahman Ali EL  
Mahdi

*Faculty of Agriculture, Nile Valley University, Sudan*

**Corresponding author:** amahdi54@hotmail.com

**ABSTRACT**

The present study was carried out in Wadi Abu Salam (63 Km. east of Berber, River Nile State, Sudan), during 2004/5 and 2005/6 seasons. The life cycle of two major desert plant species, Senna (*Cassia italica*) and Handal (*Citrullus colocynthis*), were studied. For the purpose of this study, Wadi Abu Salam area is divided into three sections; upper, middle and lower. The life cycle of Senna plant was 121 and 112 days in the first and second seasons, respectively. Handal plant completed its life cycle in 137days in both seasons. The plant height of Senna was 82cm in both seasons. For Handal, the plant length was 77 and 107cm. in the first and second season, respectively.

**Keywords:** *Cassia, Citrullus, colocynthis, Handal, Italica, Senna*

## تقويم دورة حياة نباتي السنمكة والحنظل الصحراويين

عثمان البوصيري محمد وعبد الرحمن علي المهدي

كلية الزراعة - جامعة وادي النيل - السودان

أجريت هذه الدراسة خلال موسمي (05/2004) و(06/2005) في وادي أبو سلم علي بعد 63 كم شرق بربر، ولاية نهر النيل، السودان، علي نوعين من النباتات الصحراوية هما السنمكة *Cassia italica* والحنظل *Citrillus colyonthsis*. الهدف من هذه الدراسة وصف وتحليل وفهم ميكانيكية دورة حياة كلا النوعين من إنبات البذرة حتى وضع البذور. قسم الوادي (لغرض هذا البحث) إلي ثلاثة أقسام: علوي، أوسط وأسفل. أكمل نبات السنمكة دورة حياته في 121 و 112 يوم في الموسم الأول و الثاني علي التوالي، ونبات الحنظل في 137 يوم في كلا الموسمين. أعطت نباتات السنمكة ارتفاع بلغ 82 سم في الموسمين. ونبات الحنظل بلغ طوله 77 و 107 سم في الموسم الأول و الثاني علي التوالي.

## Introduction

One group of plants belong to exerophytic species can grow in deserts in low places where water is found. They are natural graze for animals especially in rainy season. Other are unpalatable for animals and drought tolerant. These plants complete their life-cycle in the next season. The plants provide vegetation cover, minimizing drought hazards, desertification and erosion. In Sudan, more than 40% of the area is desert or semi-desert, receiving less than 90 mm of annual rainfall (Noordwijk, 1984). The Northern region lies approximately between latitudes  $17^{\circ}$  –  $22^{\circ}$  N and longitudes  $25^{\circ}$  –  $36^{\circ}$  E. The remaining area, away from the Nile, is classified as desert (Anon, 1987). This region is characterized by its desert climate with hot summers and warm winters.

Senna (*Cassia italica*) and Handal (*Citrullus colocynthis*) are annual herbs and grow at the beginning of rainy seasons. Handal is a creeping annual plant that grows under the same conditions as Senna. Both species were used in many medicinal applications. Senna is used for digestive system and rheumatism diseases, while Handal is used for skin diseases for animals. Furthermore, Handal is a good source of tar oil that is used in tanneries. These plants, although they grow irregular and neglected in their origins, now received more attention worldwide and became as exportable crops. They are usually collected in a very primitive way. They began to disappear from many districts in Sudan as a result of frequent droughts in addition to other factors such as fires and cultivation in rain fed valleys.

The ecology of wadi Abu Salam was studied as a representative of many wadies in the Northern Region of Sudan. Running through the Nubian Desert, the wadi receives sporadic low rainfall. The soils of the wadi are generally classified as Entisols, formed in situ by colluviums and alluvium and are mainly affected by wind erosion due to the low vegetation cover (Mohamed, 1989). Cloudily-Thompson (1965) concluded that, this type of sandy desert usually occurs where sand is relatively scarce and the wind direction is constant. Different groups of nomads, semi-nomads and seasonal cultivators use the wadi. Herbs and grasses compose 75% of wadi Abu Salam vegetation, many of which are palatable and of high nutritive value. Often they support the indigenous animal population for a considerable part of the year. The main sources of income are the sale of livestock and/or agricultural crops to satisfy the essential requirements (Mohamed, 1989).

Due to overgrazing and continuous cultivation, combined with prolonged drought, the vegetation cover of the wadi was greatly reduced. This led to many problems, the most dangerous of which are soil erosion in cultivated areas and sand encroachment over different places.

Senna plant can stand high temperatures during the different stages of growth. Therefore, it gives higher yields in warm climates than in temperate and semi- temperate climates. It grows extensively when planted in highlands in Equatorial or semi- Equatorial areas. In addition, it may be possible to grow it in all agricultural areas if the soil is well aerated, fertile, well filled and rich in organic matter (Haikal and Omer, 1993). However, if

Senna plants are exposed to short periods of snow or cold spell, its branches will dry out (Abu Zeid, 1986; A. A. A. D., 1988; Haikal and Omer, 1993; EL Djoy, 1996).

Senna is more favorable in sandy soils, with high organic matter and in light alluvium and heavy clay to obtain a high yield of glycosides (Saber, 1961). Fairbairn and Shrestha (1967) concluded that the total content of anthraquinones glycosides is high 65 days after planting and decreases when the plant reaches 150–160 days, which is the time for fruit formation. The Senna growing in hot and dry climate in Sudan produces higher quantities of glycosides (2.7%) compared to those growing widely in districts with similar climate- hot and relatively humid- in Southern Egypt and Eastern Desert (2.3%).

Handal (*Citrullus colocynthis*) occurs in many places in Middle East, from the north to the hot desert, in sandy soil and wadies. It flowers between May and August (Feinbrum – Dothan, 1978). It grows intensively in very hot and low humidity places in arid and semi arid environments, which are characterized by low rainfall especially in summer season when the temperatures are high and with longer light periods. It grows best in light soils especially in sandy and loamy soils and believed to tolerate high salty and alkaline conditions as well as infertile and poor soils (Abu zeid, 1986).

Handal regenerates by seeds in early summer and grows well in sandy soils and therefore it is easily spread to desert areas. Fruits ripen in October – November (Haikal and Omer, 1993 and ELDjoy, 1996). When fruits ripen, its color becomes yellow and the skin thick. Leaves become

yellowish and dry. The fruits are then collected and dried in a shady place or under the sun. In other cases it could be possible to cut the fruit into small pieces and put them in spreaders to dry up, it may also be possible to dry the fruits artificially inside ovens with temperatures ranging between 40 and 50 °C (Abu zeid, 1998; Haikal and Omer, 1993 and EL Djoy, 1996). Darwish *et al.* (1974) stated that sun drying or in the shade is preferable than the artificial drying especially when the fruits are cut to small pieces.

The objectives of this study is to describe, analyze and understand mechanisms and processes involved in the life cycle of each species from seed germination up to seed setting.

### **Materials and Methods:**

The experiments were carried out during the seasons 2004/5 and 2005/6 on Abu Salam Wadi (valley), Berber, River Nile State, Northern Sudan (Latitude 17° 22' N, Longitude 25° 36' E).

Wadi Abu Salam is geographically divided into eleven parts using a GPS (GARMIN, GPS, and 12 XL. Personal Navigator, 1998 GARMIN Corporation). Table (1) showed the parts name and locations and the distance from Nile bank. The wadi is divided into three equally sections (Upper, Middle and Lower). Each section extends 21Km. The eleven parts are grouped according to the ecological similarity.

The upper section covers the area from Jebal Abu Salam to Umm Rueit and, composed of four parts. The middle section, from EL Kubsit to

Umm Simera, composed of four parts and the lower includes the last three parts, Umm Sarih, Dabal, and EL Ku.

### **Data collection**

#### **Life cycle analysis**

Random plant samples in upper, middle and lower sections of the wadi were used. The life cycle of each plant was followed through laps of time from emergence, first 2-4 leaves, first flowering, first fruits setting, second flowering, first seeds formation and 2<sup>nd</sup> fruits setting and 2<sup>nd</sup> seeds formation. The above stages were observed through regular visits at ten days intervals, to chart and date the plants progress.

#### **Statistical analysis:**

Data were subjected to probability analysis (MSTAT- C program, 1991) to calculate regression and Dunken Multiple Range Test.

### **Results and Discussion:**

#### **Life cycle of Senna:**

The development of Senna plant at different growth stages and duration to senescence of plant life cycle for seasons 2004/05 and 2005/06 are shown in Fig. (1, a and b) The life cycle of Senna plant in the first season, where the rainfall covered only the middle section of the wadi, can be summarized in the following: 15 days between the emergence and first 2-4 leaves stage; 48 days through first flowering stage and the complete life- cycle is about 121 days. In the second season rain fall covered the three sections of the wadi,

yet Senna plants were absent in the lower section and the plant completed its life cycle in 109 to 116 days at the upper and middle sections, respectively. The life- cycle of Senna plant was significantly longer in the middle section in the 1<sup>st</sup> season and in the upper and middle sections in the 2<sup>nd</sup> season (Table 2).

### **Life cycle of Handal**

The development of Handal plant during different growth stages and the duration for each growing stage to senescence of its life cycle for both seasons is shown in Fig. (2, a and b) In the first season, rainy showers covered the middle section only. The life cycle of Handal as followed in this section was completed in 137 days. In the second season, where the rain covered the three sections of the wadi, the plant completed its life cycle in 120, 142 and 156 days in the upper, middle and lower sections, respectively. There was a significant difference ( $P < 0.05$ ) between Handal plant life cycle in the three sections. The mean life cycle of Handal plant in the three sections of Wadi Abu Salam for the two seasons are shown in Table (2). The longer period of Handal life cycle in the lower section of the wadi could be attributed to the higher levels of moisture in this section compared to other sections, especially at 30- 60 cm. depth which represents the limits of the layer that hold the plant roots spreads. In addition to that, the sandy top layer of the soil at 0 - 30 cm depth in this section made the spread of roots easier. The fact that Senna and Handal plants are seasonal desert plant and that they complete their life cycle during the rainy season and spread their



seeds waiting for the next rainy season, were confirmed by results obtained by EL- Gazali *et al.* (1994).

### **Height of Senna**

Height of Senna plant during 2004/5 and 2005/6 seasons is shown in Fig. (3, a and b). In the 1<sup>st</sup> season the mean plant height of Senna reached 82 cm. The plant growth accelerated at the vegetative growth period before the flowering stage and reached a height of 60 cm. At the final stages of growth, the increment in plant height slowed down as a result of transferring photosynthesis products to satisfy the need of flowering and fruit development and the decrease in soil moisture content. During the 2<sup>nd</sup> season, the Senna plant reached a mean height of 71 and 90 cm. at upper and middle sections, respectively. However, the mean plant height for the two seasons was 82 cm. The mean height of Senna plants were significantly different ( $P > 0.05$ ) (Table 3). These results generally agree with the findings of Grieve (1984), Wickere (1984) and EL Amin (1990) who generally reported Senna plant height as 16- 60 cm. However, Abu Zeid (1986), A.A.A.D (1988), Haikal and Omer (1993) and EL Djoy (1996) found that the Senna plant height ranged between 50-200 cm.

### **Length of Handal**

Length of Handal plant during 2004/5 and 2005/6 seasons is shown in Fig. (4, a and b). During the 1<sup>st</sup> season, the average Handal plant length reached 112 cm. The plant length development increased during the vegetative period before first flowering, with an increment of 77 cm. while during late

development stages, the increment in plant length decreased. This could be attributed to transfer of assimilate supply towards production of fruits and seeds and to the depletion of soil moisture content during this stage. The results during 2005/6 season showed that, the mean lengths of Handal plants were 86, 109 and 126 cm. for upper, middle and lower sections, respectively. The difference in plants length in the two seasons and in the three sections of the wadi was found highly significant ( $P>0.01$ ) (Table 3).

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**Table 1: Wadi Abu Salam sections names, GPS and distance from Nile Bank.**

	No	Site Name	GPS	D. From Nile bank /km
<b>Upper</b>	1	EL Musgur	N 18,00', 103" E 34,28,659"	63.60
	2	EL Yuet	N 18,03', 410" E 34,19', 637"	54.70
	3	ELSalobit	N 18,20', 718" E 34,19', 625"	51.70
	4	Umm Rueit	N 18,20', 718" E 34,19', 626"	47.50
<b>Middle</b>	5	EL Kubsit	N 18,01', 680" E 34,17', 694"	42.80
	6	EL Lilueit	N 18,03', 042" E 34,16', 006"	37.20
	7	Umm Beid	N 18,02', 962" E 34,13', 223"	33.60
	8	Umm Simeira	N 18,50', 800" E 34,11', 906"	28.50
<b>Lower</b>	9	Umm Sarih	N 18,06', 176" E 34,08', 902"	22.70
	10	Dabal	N 18,06', 457" E 34,05', 364"	20.70
	11	EL Ku	N 18,07', 738" E 34,04', 272"	18.20

**Table 2: Life cycle (days) of Senna and Handal plants in different sections of wadi Abu Salam during two seasons**

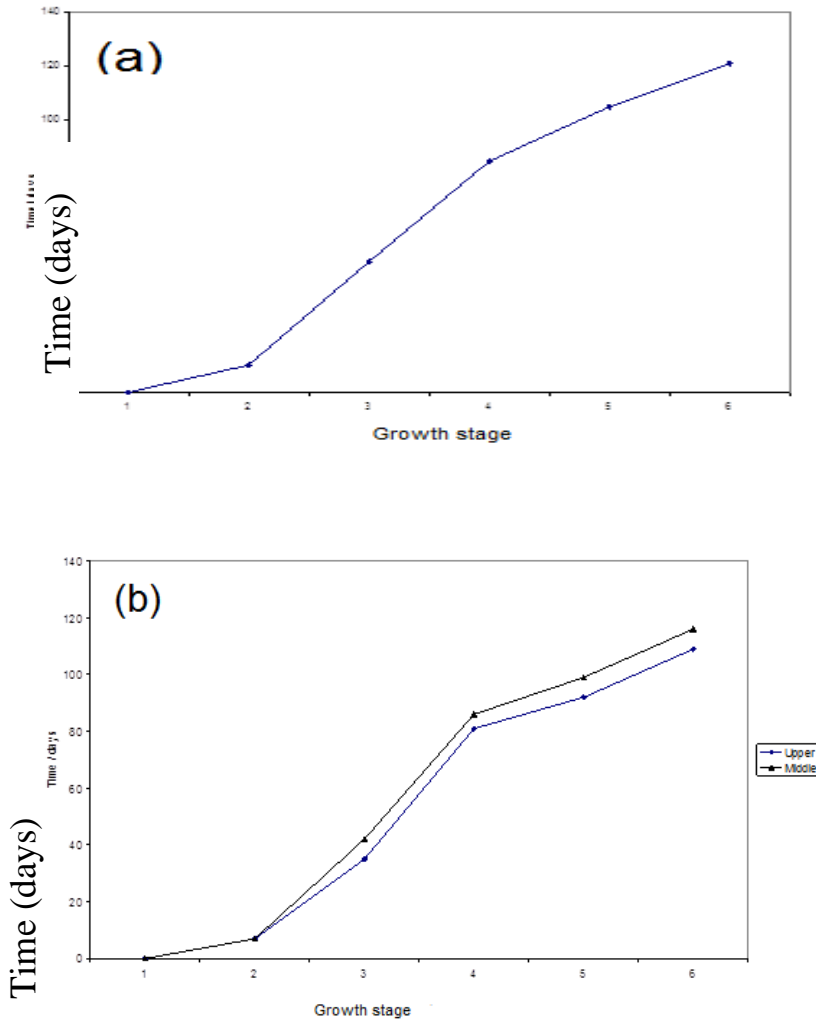
Section \ Season	2004/05		2005/06	
	Senna	Handal	Senna	Handal
Upper	0.00 b	109 a	0.00 b	120 b
Middle	121.0 a	116 a	137.0 a	142.0 a
Lower	0.00 b	0.00 b	0.0 0 a	156.0 a

Means within the same column having the same letter are not significantly different at  $P = 0.05$  according to Duncan's Multiple Range Test.

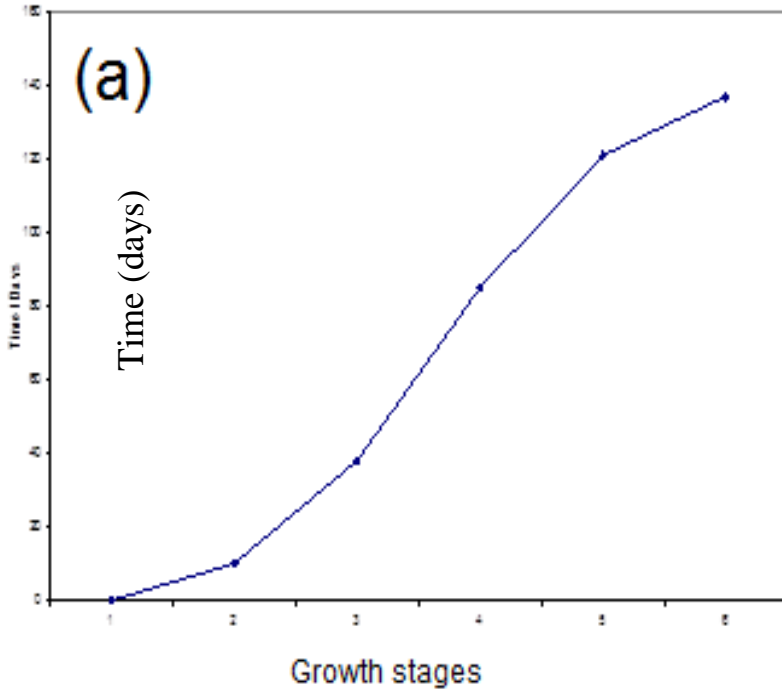
**Table 3: The height of Senna plant and plant length of Handal (cm) in different sections of wadi Abu Salam during two seasons**

Section \ Season	2004/05		2005/06	
	Senna	Handal	Senna	Handal
Upper	0.00 b	71.0 a	0.00 b	86.0 a
Middle	82.0 a	90.0 b	112.0 a	109.0 b
Lower	0.00 b	0.00 c	0.00 b	126.0 b

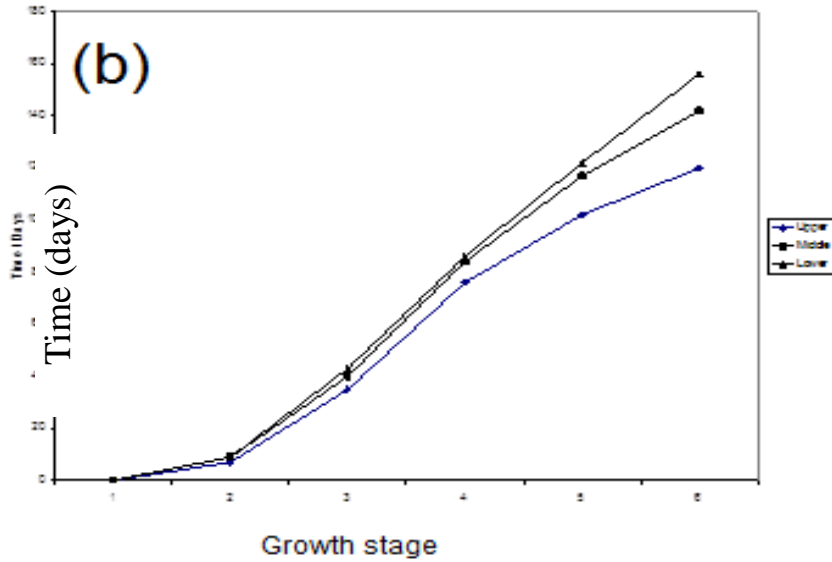
Means within the same column having the same letter are not significantly different at  $P = 0.05$  according to Duncan's Multiple Range Test.



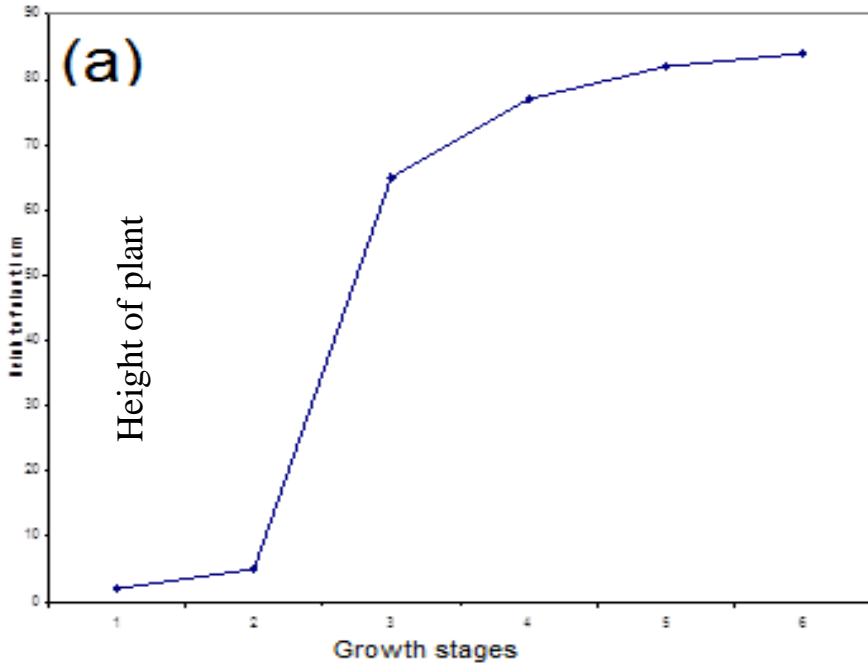
**Fig. 1:** The life cycle of Senna plant (days) during two seasons: (a) Season 2004/5 (b) Season 2005/6 at different wadi sections (Upper, Middle, Lower) and different growth stages (1- emergence, 2- first 2 -4 leaves, 3- first flowering, 4- first fruits setting and 2nd flowering, 5- first seeds formation and 2<sup>nd</sup> fruits setting and 6- 2<sup>nd</sup> seeds formation).

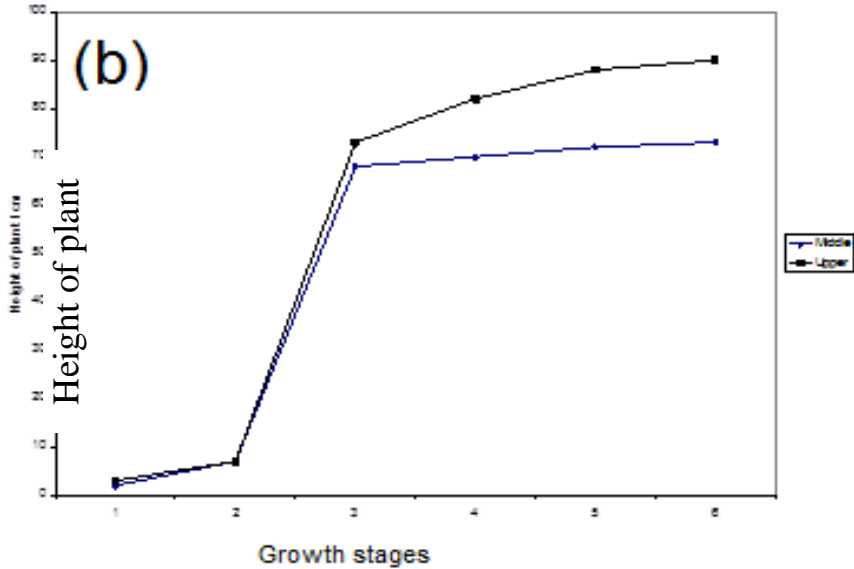




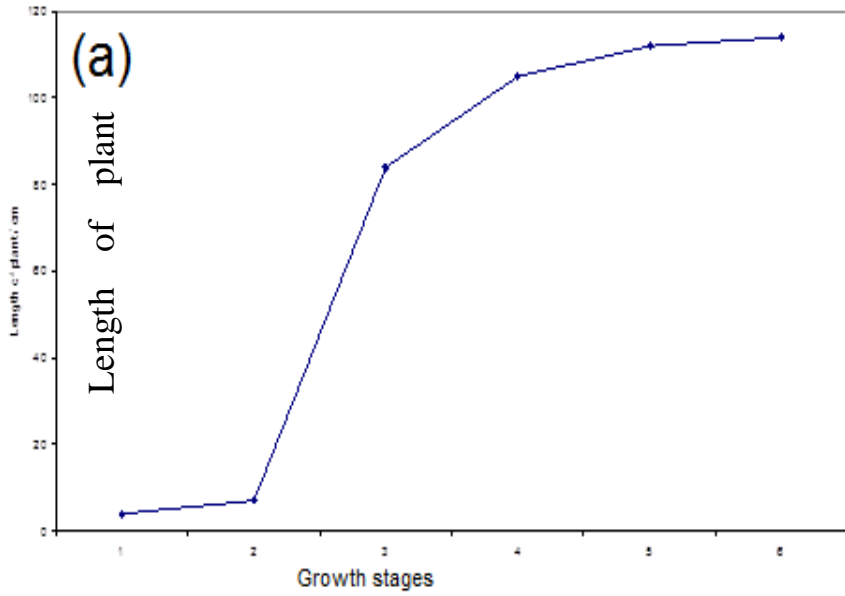


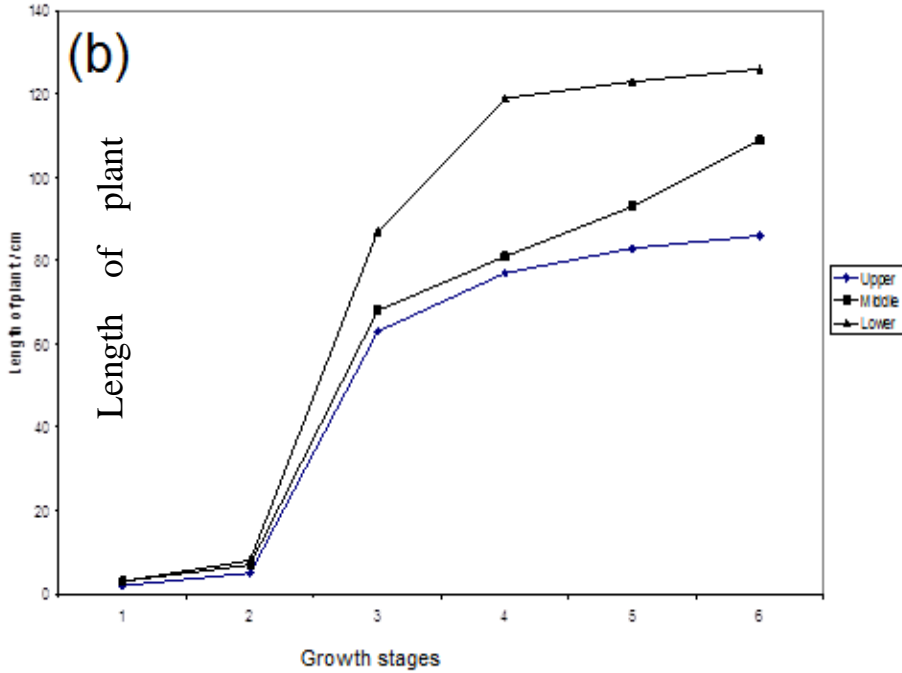
**Fig. 2:** The life cycle of Handal plant (days) during two seasons: (a) Season 2004/5 (b) Season 2005/6 at different Wadi sections (Upper, Middle, Lower) and different growth stages (1- emergence, 2-first 2 -4 leaves, 3-first flowering, 4-first fruits setting and 2nd flowering, 5- first seeds formation and 2<sup>nd</sup> fruits setting and 6- 2<sup>nd</sup> seeds formation.)





**Fig. 3:** Height of Senna plant (cm) during two seasons: (a) Season 2004/5 (b) Season 2005/6 at different Wadi sections (Upper, Middle, Lower) and different growth stages (1- Emergence, 2- First 2 -4 Leaves, 3- First Flowering, 4- First Fruits Setting and 2<sup>nd</sup> Flowering, 5- First Seeds Formation and 2<sup>nd</sup> Fruits Setting and 6- 2<sup>nd</sup> Seeds Formation).





**Fig. 4: Length of Handal plant (cm) during two seasons: (a) Season 2004/5 (b) Season 2005/6 at different wadi sections (Upper, Middle, Lower) and different growth stages (1- emergence, 2- first 2-4 leaves, 3- first flowering, 4-first fruits setting and 2<sup>nd</sup> flowering, 5- first seeds formation and 2<sup>nd</sup> fruits setting and 6- 2<sup>nd</sup> seeds formation)**