Hebron University Research Journal.
Vol.(3), No.(2), pp.(1 – 21), 2008

H.U.R.J. is available online at
http://www.hebron.edu/journal

Growth and Development of Range Plants in Southern West Bank

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Abstract:

Vegetation biomass, cover and density were evaluated and monitored during the growing season at three sites: Bani-Noiem (MBN), Sorif (SM), and Dura (DAA), that represent different environmental conditions (Mediterranean climatic zone and semi-arid zone). Square plots were used to evaluate vegetation biomass and density. Step-point method was used to estimate ground cover.

Vegetation biomass increased drastically at the three sites one month after a main rainfall storm. The plant biomass peaked during mid March and mid April, and its values varied between sites and between years. In 2004, the values were 899, 3809, and 2974 kg/ha in MBN, DAA, and SM, respectively; whereas, it was 2105, 2375, and 2302 kg/ha in MBN, DAA, and SM during 2005, respectively.

Short herbaceous plants were highest in MBN, while SM had the highest shrubs biomass. Similarly, MBN showed plant density (645 plants/m2 and 518 plants/ m2 in 2004 and 2005 years) relative to the other sites. In all sites, forbs cover higher than grasses and shrubs cover (73 %, 36 %, 62 % at MBN, DAA, and SM, respectively).

Reproduction system, moisture and soil characteristics favored forbs growth over other vegetation types. The dominant plant species was varied between the sites and seasons.

Key words: Biomass, plant cover, plant composition, soil moisture.

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نمو وتطور نباتات المراعي في جنوب الضفة الغربية

الملخص:

في هذة الدراسة تم قياس و متابعة كمية المادة الجافة والغطاء النباتي و كثافته خلال فصول النمو في ثلاث مناطق (بني نعيم / صوريف / دورا). هذه المناطق تمثل انماط بيئية و مناخية مختلفة (مناخ حوض البحر المتوسط و مناخ المناطق شبه الجافة).

استخدمت طريقة المربع لقياس كمية المادة الجافة و كثافة النباتات و طريقة الخطوة لقياس الغطاء النباتي.

أظهرت النتائج أن كمية المادة الجافة زادت بشكل كبير في الثلاث مناطق بعد مرور شهر واحد من نزول الأمطار الغزيرة و يصل نمو النباتات ذروته خلال الفترة ما بين منتصف شهر آذار و منتصف شهر نيسان.

تختلفة كمية المادة الجافة في ذروة النمو الخضري بين المواقع و بين الاعوام، حيث تصل إلى 899 و 3809 و 2974 كغم / هكتار في بني نعيم و دورا و صوريف على التوالي في عام 2004. و ايضا وصلت الكمية إلى 2105 و 2375 و 2302 كغم / هكتار في بني نعيم و دورا و صوريف على التوالي في عام 2005.

وجد بان كثافة النباتات كانت عالية في بني نعيم (645 نبات / م2 و 518 نبات / م2 في عامي 2004 و2005 على التوالي) مقارنة بالمواقع الأخرى.

في مواقع الدراسة الثلاث تبين أن نسبة الغطاء النباتي من النباتات شبه العشبية اعلى من الاعشاب و الشجيرات (73%، 36%، 62% في بني نعيم و دورا و صوريف على التوالي).

طريقة التكاثر، رطوبة و خصائص التربة تناسب نمو النباتات عريضة الأوراق في هذه المناطق و خاصة دورا وصوريف. بالإضافة لذلك أظهرت النتائج أن الأنواع للنباتات السائدة تختلف بين المواقع، و ايضا تختلف خلال فصول النمو.

Introduction:

Identifying temporal and spatial changes in range plant community during the growing season are essential for proper range management. Seasonal changes in vegetation cover, density and biomass are closely associated with climate and soil. Seasonal changes in plant growth and form are decisive in determining the plant's adaptation to a seasonally changing environment (Diaz, *et al*., 1990), in arid and semiarid rangelands is a key factor that influenced individual and community vegetation characteristics (Parker, 1988). Soil depth strongly affects plant phenology and several parameters of plant productivity, all of which increased with increasing soil depth (Kutiel and Noy-Meir, 1986). At micro-scale, vegetation patterns were correlated with rock, and crevice microtopography (Whittaker *et al*., 1983), also the rock/soil ratio is an important

surface property that can determine soil moisture storage and distribution.

Palestinian rangeland considered one of the richest Mediterranean rangeland in plant diversity due to the presence of numerous geographical regions. Each of these has its particular climatic, edaphic and biogeographic characteristics (Zohary, 1947). The occurrence of suitable microsite for establishment of certain species will determine their presence and abundance within the community, and in the long term this may modify the successional trajectory of the community (Sternberg *et al*., 1999).

Although, the geomorphological structures are relatively small in Palestine, but the number of rock types is high. As a result, many soil types developed in a small area (Dan & Raz 1970) increasing the diversity of habitats. This coupled with high variability in the climatic and topographic factors, led to the presence of large number of plant species.

An analysis for flora in Palestine carried out by Eig (1931), indicated the presence of 2172 plant species. While in a recent study, Danin (2002) recorded 2825 species. These plant species where distributed in one or more of the following climatic zone: Mediterranean region, Irrano-Turanian, Saharo-Sindian, and Sudano-Deccanian (Zohary, 1947).

Lack of knowledge on the pattern of the growth attributes of the vegetation in Palestinian rangeland is one of the main obstacles facing the building of a suitable range management and improvement programs. Therefore, the objective of this research is to study the growth pattern of plant community, vegetation composition, and monitoring vegetation biomass, cover, and density during the growing season under Mediterranean climate and semi-arid zones at Southern West Bank.

Materials and methods

Study Area

This study is part of a large project entitled "Monitoring and Evaluation of Watersheds in the Middle East Region". The study was conducted at three sites that represent semi-arid and Mediterranean climate in Hebron District. The first site, Massafer Bani-Noiem (MBN), covering an area of about 45 hectares, MBN (31º 28º, 35º 10º) located 8 km east of Hebron city at an elevation of 670 m (GIS, 2004). MBN has a hilly topography with a 250-300 mm average annual rainfall and affected by the rain shadow (MOA, 2004). The site is classified as semi-arid region. The second semi-arid site, Deir Al-asal (DAA) covering an area of about 2 hectares. DAA (31º20º, 34º57º) is located 18 km south west of Hebron city at an elevation of 480 m (GIS, 2004), where the average annual rainfall is 361 mm (MOA, 2004). The third site, Sorif-Mzera'a (SM) had a 50 hectare area. SM (31º37º, 35º03º) is located 15 km north west of Hebron city at an elevation of 680 m with a 400-500 mm average annual rainfall (ARIJ, 2001). The climate in this site is classified as Mediterranean climate. The slope gradients are 10°, 11°, and 8° at MBN, DAA, and SM, respectively.

The soil at MBN and DAA is Brown Rendzinas (Awadalla and Owaiwi, 2005) which contains a relatively low amount of clay 25% and 26% respectively, and organic matter 2% and 3.5% respectively (Al-Seikh, 2006). However the soil in SM is terra Rossa, which contains moderate amount of clay (39%) and low amount of organic matter (3.85%). Detailed soil chemical and physical properties for the study sites are described by Al-Seikh (2006).

1. Biomass

In each site, vegetation biomass was estimated by determining the biomass in ten random square plots (25 x 25 cm^2). Data was recorded frequently at about one month interval starting from early January until the end of May. The current year growth of each plot was clipped to the soil surface and oven-dried (65º c) for 48 hours, and the oven-dry biomass was recorded.

2. Monitoring vegetation cover

A one hundred step-point method was used along a random transects to estimate ground cover at each site. Data was recorded monthly during the period from January to May (Bonham, 1989). Plants were identified according to Al-Eisawi 1998, Zohari 1966, Burnie 1995, and Ori *et al.* 1999.

3. Plant density

At each site, fifteen 0.25 m2 quadrates (replicates) were allocated randomly. The number of all species, and the number of individual of each species was recorded for each quadrate at the time of community peak growth.

Statistical analysis

The data of dry biomass and plant density for the years 2004, 2005 were analyzed by using Sigmastat® program, one way ANOVA, with Fisher multiple comparison test ($P \leq 0.05$).

Results and discussion

1. Plant Biomass

Plant biomass increased gradually during the growing season and reached the peak during the period from mid March to mid April (Fig. 1). Although vegetation growth started early in the winter following the onset of rainfall, but a drastic increase in plant biomass was occurred about one month after the first main storm event, mid February during 2004 and mid of January during the 2005. Sites showed significant differences ($p \leq 0.05$) in the peak value biomass. The highest oven-dry weight was obtained during mid March, 2004 and mid March to mid April, 2005 (Figure 1). Mohammad (2000, 2005) reported 980 kg/ha biomass at MBN. Our results agreed with that of Zady *et al*. (2001) who found that under similar

environmental conditions, the vegetation production increased until March then it decreased. This decrease might be due to the dry-hot environmental condition and also related to wild life and other herbivore's grazing. Rainfall and rainfall attributes (rainfall variability, rainfall intensity, number of rainy days, length of dry and rainy season) are the most important climatic factor affecting natural pasture production (Le Houro and Host, 1977).

Interannual variation in plant growth was strongly related to both winter precipitation and temperature (Parker, K.C. 1988 and Kemp, R. P. 1983). Diaz *et al*. (2001) and Marcelo *et al*. (2000) indicated that the Mediterranean climate is characterized by a high year to year variability in rainfall.

The difference between sites in dry biomass during the growing season and at the peak growth period is explained by the differences in the environmental factors between these sites, MBN is considered as semi-arid area located in the rain shadow by which it has lower amount of rainfall compared to other sites. In addition, the soil in MBN is shallower than that in SM and DAA and has lower organic matter (Al-Seikh, 2006), where he found that, the percent of organic matter at SM increased by 25 % and 54% comparing with that of DAA and MBN, respectively. Therefore, it has lower ability to conserve soil moisture and provide the potential for high plant growth. When these factors are associated with lower amount of rainfall and higher amount of evapotranspiration, this led to lower vegetation growth in MBN site. Similar results were observed by Mohammed (2000) at the southern part of West Bank. He concluded that the distribution of the precipitation during the growing season and soil characteristics determine range land productivity. However, SM site received high amount of rainfall during the season (figure 2), and it is higher by 46% and 4% when compared with MBN and DAA respectively. Other factors that contributed to lower vegetation production in MBN is the nature of plant species which grow in a semi-arid area. These plants are found to be dwarf and small with very short life cycle which compared with those plants grow in the Mediterranean climate in SM site. Zady *et al.* (2001), under similar environmental conditions to our sites, found also that dry biomass varied between the sites. Similar results was founded by Kutiel and Noy-Meir (1986), where they concluded that soil depth strongly affected plant phenology and several parameters of plant productivity, all of which increased with increasing soil depth. Growth retardation in shallow soils is associated mainly with the unfavorable moisture regime and the limited soil volume, restricting growth of the root system and thereby of the whole plant. Whittaker *et al.* (1983) mentioned that large scale gradients of vegetation were related to differences in soil moisture availability. Kutiel *et al.* (1995) found that changes along the climatic gradient were found to be within a narrow belt exists at 300 mm of annual precipitation in which a drastic decline in all plant parameters occurs at lower annual precipitation. In our study, this belt represents the differ-

ence between SM and DAA site from one side and the MBN on the other side in the average annual precipitation.
Identifying changes in plant biomass through the growing season, and the time and amount of plant growth peak are important in setting up the suitable range management plan. Such information about the vegetation community is essential to determine the suitable stocking rate and grazing time, in addition to setting the plans for range improvement

2. Plant density

Results in Figure 3 (a, b) show significant ($P \leq 0.05$) difference in plant density between sites. MBN has significantly higher plant density than SM and DAA sites during the years of the study. The average plant density for MBN, SM and DAA sites at the peak growth period was 645, 124 and 124 plants/m^2 in 2004 and 518, 242 and 229 plants/m^2 in 2005, respectively. The higher plant density in MBN site is due to the nature of plant species in that area. This area is considered as semi arid area and it is characterized by large number of small-short life forbs and grasses such as *Poa bulbosa*. On the other hand, SM and DAA sites are dominated by low numbers of large shrubs and grasses such as S*arcopoterium spinosum and Avena sterilis*, respectively. Osem *et al*. (2002), in a study conducted under the Mediterranean climate, found that in semi-arid area the herbaceous annual vegetation has high diversity. Kutiel *et al.* (1995) found that higher life forms occur in Mediterranean regions whereas lower life forms, mainly annuals and crytogams, predominate in arid regions. The difference between years is mainly due to differences in the amount and distribution of precipitation (Fig. 2).
Plant density might be not essential in setting stocking rate and grazing system, but it is very important vegetation attribute in evaluating the influence of environmental factors and management practices on vegetation conditions and trends. In addition, plant density by species can provide a direct indication about plant diversity. In our study, plant diversity is high in all three sites, but in MBN is the highest, this is because MBN influenced by the vast nearby Negev Desert to the south and the Jordan Valley to the east (Mohammed, 2000). Results obtained by Arnson, A., and A. Shmida (1992), indicated a lack of clear correlation between rainfall and species diversity in the Mediterranean stations.

3. Vegetation cover

Vegetation cover percentage increased dramatically with time during the growing season which started from early January until it reached the peak of vegetation cover at each study site, then it decreased (Figure 4). Early in the growing season , percent plant cover was higher in SM (71%) and DAA (59%) than that in MBN (21%). This might be due to the high percentage of evergreen shrubs in these two sites compared with MBN site. Although the shrub species available in SM and DAA are mainly not palatable species for ru-

minant, this indicates the importance of increasing the presence of palatable shrubs for ruminant animals to provide green vegetation during the long dry summer and early winter.

The peak of vegetation cover percentage varied between sites. In MBN the peak was at April with 94 % cover, while at SM the peak reached in early March and stays constant until May with the same percent. This difference between sites might be due to differences in the amount of precipitation, available soil moisture, and plant life forms. MBN has lower amount of annual precipitation; the soil dries up early and it was found that most of the plants adapted to these condition by having short life cycle. Therefore, the plants dry out earlier than at the other two sites.

In plant community the species composition affects the growth of all compartments of the community (Kanninen *et al*., 1982). In our study, vegetation composition was also investigated and the percent of forbs, grasses, and shrubs was measured at the three sites (figure 5). The data showed that the percent of forbs were the highest in all sites (73 %, 36 %, 62% in MBN, SM, and DAA, respectively). However, the shrubs have the lowest percentage at all sites. The high percentage of forbs compared with shrubs and grasses might be due to differences in reproduction methods, where forbs depend mainly on producing large number of seeds like medics and trifolium, while shrubs and perennial grasses were largely reproduced by stolons and rhizomes (Kemp, 1983), and these are much slower in dispersion than seed reproduction system. Marcelo *et al*. (1999) indicated that the Mediterranean ecosystems have a large number of annual plants in the floristic composition.

The percentages of the different plant species were varied during the growing season and between the study sites (Table1). These variations might be due to physiological and morphological adaptation of the different plant species (Kemp, 1983), each being adapted for utilizing a particular phase of the seasonally and yearly variable water, which reflects different phenology for these species.

Plant species which have high frequency, abundance, and density at the peak growth stage were considered as dominant species. Results in tables (1, 2, and 3) show changes in the plant species cover during the growing season. Some plants appeared early in the growing season, others appeared late. Apparently the germination of seed and regrowth of herbaceous and perennials are influenced by soil moisture and temperature at each of the three sites. Therefore, there is some variation in dominant species during the growing season, and also between sites. At MBN site, the dominant species at the peak stage-April include: *Poa bulbosa, Anthemis spp., Erodium gruinum, Lomelosia palaestina, Trigonella spp, Crepis aspera, and Onobrychis caput-galli*. While at SM site, the dominant species were, *Sarcopoterium spinosum, Avena sterilis, Lolium spp., Plantago coronopus, Aegilops spp., Trifolium spp, Phalaris spp*. However, at DAA site, the dominant species were, *Crupina crupinastrum, Avena sterilis, Anagallis arven-*

sis, Asphodelus aestivus, Onobrychis caput-galli, Trigonella spp., and Anchusa spp.

In setting grazing management plan, changes in plant community during the growing season under similar environmental conditions should be considered to have optimum utilization for the rangeland vegetation.

Management Implication and Recommendation:

Under environmental conditions similar to our study sites, the following are important points to be considered in setting range management plan:

• Grazing can be started one month following to the first main rain storm.

• Grazing capacity can be estimated according to the range plant production during the period mid March to mid April.

• Palatable shrubs may protect soil and provide green livestock food for a longer period.

• More research is needed our study areas to determine carrying capacity of the range land, the appropriate time to remove the animals from the range, to determine palatability and nutritive value of the dominant plant species.

Acknowledgment:

I would like to express my thanks and appreciation to the MERC Institute, US Forest Service, and US State Department for their generous funding for the project.

Also many thanks extended for Khaled Hardan, Osama Al-Jo'beh, Saleh Alsiekh, and Mohammad Al-Adam for their great help in data collection and laboratory analysis.

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Table (1) Change in vegetation cover percent at Bani-Noiem study site during 2004, 2005

Bani-Noiem/100 steps		2004							2005				
Arabic Name	**Scientific name**	6.1	28.1	18.2	10.3	29.3	3.5	9.6	15.1	20.2	15.3	6.4	2.5
شقائق النعمان	*Adonis sp.*	0	0	0	0	0	0	0	0	0	1.15	0	0
شعير بليس	*Aegilops sp.*	0	0	0	0	0	0	1.23	0	0	0	0	0
ثوم	*Allium sp.*	0	2	4.11	1.19	1.09	1.11	0	11.94	9.41	1.15	0	0
عين الجمل	*Anagallis arvensis*	0	0	0	0	0	0	0	0	0	1.15	0	0
حمحم	*Anchusa sp.*	0	0	0	2.38	0	2.22	1.23	0	0	1.15	0	0
اقحوان	*Anthemis sp.*	0	0	2.74	8.33	11.7	5.56	4.49	5.97	10.59	11.49	7.35	11.49
شجرة الارنب	*Arnebia tinctoria*	0	0	0	0	0	1.11	0	0	1.18	0	2.15	0
غيصلان	*Asphodelus aestivus*	19.05	6	5.48	2.38	2.17	2.22	1.23	2.99	5.88	1.15	1.15	1.15
بلبوس	*Astomaea seselifolium*	0	0	0	0	0	0	0	0	2.35	2.3	0	0
كداد	*Astragalus spinosus*	0	0	0	0	1.09	0	0	2.99	1.18	0	0	0
شوفان بري	*Avena sterilis*	0	0	0	1.19	1.19	1.11	2.74	0	1.18	1.15	0	1.15
رغيف الراعي	*Biscutella didyma*	0	0	0	0	1.09	1.11	3.7	0	0	0	0	0
ثرغول	*Bromus sp.*	0	0	0	0	1.09	2.22	1.23	0	0	1.15	3.23	1.15
شوكة حمار	*Carlina curetum*	0	6	2.74	3.57	1.09	1.11	1.23	4.48	9.41	1.15	1.08	0
قوس	*Carthamus tenuis*	0	0	0	0	0	1.11	3.7	1.49	0	2.3	0	3.45
مرار	*Centaurea sp.*	9.52	0	0	0	1.09	0	1.23	0	0	0	3.23	1.15
علك	*Cichorium pumilum*	0	0	2.47	0	0	1.11	0	0	2.35	0	2.15	1.15
صفيره	*Crepis aspera*	0	0	0	0	1.09	0	0	0	0	0	5.38	4.6
شوكة جمل	*Echinops polyceras*	0	20	15.07	10.7	0	6.67	13.58	10.45	7.06	4.6	4.3	4.6
ابرة العجوز الكبيره	*Erodium gruinum*	9.52	12	6.85	14.29	9.77	2.22	3.7	17.91	16.47	9.2	12.91	2.3
قرصعنه	*Eryngium creticum*	0	6	4.11	2.38	1.09	0	2.47	2.99	0	4.6	3.23	3.45
قطينه	*Evax contracta*	0	0	0	0	0	0	0	0	1.18	0	0	0
	Forbs	0	0	0	0	0	0	0	0	0	0	0	5.75
اعشاب	*Grasses*	42.86	28	19.18	2.38	0	1.11	19.2	13.43	1.18	0	0	0
عكوب	*Gundelia tournefortii*	0	0	2.74	4.76	0	0	0	1.49	0	5.75	2.15	0
جريت –عدسيه	*Helianthemum salicifolium*	0	0	0	0	0	2.22	0	0	0	1.15	0	2.3
غبيره	*Heliotropium arbainense*	0	0	0	0	1.09	0	0	0	0	0	1.08	0
شعير بري	*Hordeum spontaneum*	0	3	1.37	1.19	0	0	0	0	2.35	0	0	0
ربحله	*Lactuca orientalis*	0	0	0	0	1.09	3.33	0	0	0	0	0	0
خس بري	*Lactuca sp*	0	0	2.74	0	0	0	0	0	2.35	0	1.08	0
سعيسعه	*Lathyrus cicera*	0	0	0	0	0	0	0	1.49	0	0	0	0
بقوليات	*Legumes sp.*	0	0	0	2.38	0	0	0	1.49	4.71	1.15	0	0
ركيبه	*Lomelosia palaestina*	0	0	0	0	7.6	0	0	0	0	4.6	4.3	0
دريهمه	*Malabaila secaul*	0	0	0	0	0	0	2.47	0	0	0	1.08	4.6
قرط	*Medicago sp*	0	0	0	1.19	3.26	0	0	0	0	4.6	0	1.15
خرفيش	*Notobasis syriaca*	0	0	1.37	1.19	3.26	1.11	1.32	2.99	1.18	0	1.08	2.3

جريس	*Onobrychis caput-galli*	0	0	0	0	2.17	0	1.23	0	0	3.45	3.23	0
شبرق	*Ononis sp*	0	0	0	0	0	0	0	0	0	0	2.15	0
شوكة زرقاء	*Onopordon sp.*	0	0	0	0	4.34	0	0	0	0	0	0	0
بخور مريم	*Pallenis spinosa*	0	0	0	0	0	2.22	0	0	0	0	0	0
قديح،قدحه	*Phagnalon rupestre*	0	0	1.37	2.38	0	3.33	0	1.49	1.18	0	0	0
شعير الفأر	*phalaris*	0	0	0	0	2.17	4.44	13.58	0	0	0	3.23	4.6
نزعه	*Poa bulbosa*	0	10	15.07	7.14	19.58	28.9	7.41	7.46	7.06	18.39	19.35	18.39
خرمة	*Salvia palestinia*	0	2	2.74	3.57	6.56	2.22	1.23	1.49	2.35	0	0	1.15
نتش	*Sarcopoterium spinosum*	19.05	2	1.37	2.38	1.09	4.44	2.47	4.48	0	1.15	0	0
عنجد	*Scorpiurus muricatus*	0	0	0	0	0	0	1.23	0	0	0	0	0
زيته	*Scrophularia xanthoglossa*	0	0	0	0	1.09	0	0	0	0	2.3	1.08	0
خردل	*Sinapis alba*	0	0	0	1.19	0	0	0	0	0	0	0	0
لفيته	*Sinapis arvensis*	0	0	2.74	4.76	0	1.11	0	0	3.53	0	0	0
بهمه	*Stipa capensis*	0	0	2.74	16.67	3.26	3.33	1.23	1.49	0	2.3	0	0
جلثون	*Tetragonolobus palaestinus*	0	0	0	0	1.09	0	0	0	0	0	0	0
جعده	*Teucrium capitatum*	0	0	0	0	0	1.11	0	1.49	0	0	0	0
متنان	*Thymelaea hirsuta*	0	0	2.74	2.38	2.17	1.11	1.23	0	2.35	2.3	1.08	2.3
جزر الشيطان	*Torilis tenella*	0	0	0	0	1.09	2.22	0	1.49	0	2.3	4.3	1.15
ذنب الفرس	*Tragopogon coelesyriacus*	0	0	0	0	2.17	0	0	0	0	0	1.08	0
	Trifolium spp.	0	0	0	0	2.17	8.89	4.94	0	3.53	6.9	5.38	13.79
حواجه	*Trigonella stellata*	0	0	0	0	0	0	0	0	0	0	1.08	3.45
غير معروف	*unkown*	0	0	0	0	1.09	0	0	0	0	0	1.08	3.45
	Total	100	100	100	99.97	99.85	99.9	100	100	100	100	99.79	100

Table (2) Change in vegetation cover percent at Sorif study site during 2004, 2005

Sorif/100 steps		2004						2005				
Arabic Name	**Scientific name**	15.1	26.1	24.2	20.3	12.4	14.6	16.1	21.2	21.3	17.4	18.5
شقائق النعمان	*Adonis sp.*	0	0	2.53	0	0	0	0	0	0	0	0
شعير بليس	*Aegilops sp.*	0	0	0	0	3.19	1.04	0	0	0	6.25	4.49
ثوم بري	*Allium sp.*	0	5	0	0	4.26	1.04	10.59	8.05	0	0	0
حمحم	*Anchusa sp.*	0	1.25	0	0	0	1.04	1.18	0	0	1.09	0
اقحوان	*Anthemis sp.*	0	0	0	1.09	3.19	0	0	0	0	0	0
غيصلان	*Asphodelus aestivus*	8.45	10	5.06	7.69	4.26	4.16	7.06	4.6	0	0	6.74
بلبوس	*Astomaea seselifolium*	0	1.25	0	0	0	0	0	0	0	0	0
أم خرس	*Atractylis cancellata*	0	0	0	0	0	0	0	1.15	0	0	0
شوفان	*Avena sterilis*	0	12.5	0	9.89	8.15	18.75	0	16.09	18.18	14.13	13.48
رغيف الراعي	*Biscutella didyma*	0	0	0	0	0	1.04	0	0	0	0	0
دنبان	*Brachypodium distachyon*	0	0	0	0	0	0	0	0	0	2.18	2.25
ثرغول	*Bromus sp.*	0	0	0	0	6.38	0	0	0	9.09	8.7	0
شوكة حمار	*Carlina curetum*	0	2.5	0	8.79	1.06	0	2.35	4.6	3.41	0	1.12
قوص	*Carthamus tenuis*	0	0	0	0	0	0	0	0	0	1.09	2.25
كارديليا	*Chardinia orientalis*	0	0	0	0	0	0	0	0	0	3.26	0
عيصلان، زعفران	*Colchicum stevenii*	1.41	0	0	0	0	0	0	0	0	0	0
زحيف	*Coridothymus capitatus*	0	0	1.27	0	0	0	4.71	0	0	0	0
صفيرة	*Crepis aspera*	0	0	5.06	3.29	2.13	2.08	0	0	0	7.61	0
كروبينيا	*Crupina crupinastrum*	0	0	0	0	2.13	9.37	0	2.3	4.55	5.43	3.37
قرن غزال	*Cyclamen persicum*	2.82	6.25	0	0	0	0	4.71	2.3	0	0	0
ارث	*Echinops polyceras*	1.41	0	1.27	0	0	0	0	0	0	0	0
إبرة العجوز	*Erodium acaule*	0	0	0	0	0	0	1.18	0	0	0	0
ابرة العجوز الكبيرة	*Erodium gruinum*	2.82	0	0	0	0	0	0	0	1.14	0	0
قطينة	*Evax contracta*	0	0	2.53	0	2.13	0	0	0	9.09	1.09	0
	Forbs	0	0	0	0	0	0	2.35	0	0	0	0
اعشاب	*Grasses*	21.13	3.75	11.39	2.19	0	11.45	16.74	13.79	0	0	10.11
سوسن الخنازير	*Gynandriris sisyrinchium*	0	0	0	0	0	0	0	0	2.27	0	0
رويس الجبل	*Hedypnois cretica*	0	0	0	0	0	0	0	0	0	0	1.12
جريت –عدسيه	*Helianthemum salicifolium*	0	0	0	0	0	0	0	1.15	0	1.09	1.12
ورد الشمس	*Helianthemum vesicarium*	2.82	1.25	2.53	2.19	3.19	1.04	0	3.45	2.27	1.09	7.87
شعير بري	*Hordeum spontaneum*	8.45	0	16.46	8.79	6.38	0	0	0	2.27	1.09	0
خس بري	*Lactuca sp*	4.23	0	2.53	4.39	1.06	0	3.53	0	0	0	0
سعيسعة	*Lathyrus cicera*	0	0	0	0	1.06	0	0	0	0	0	0
بقوليات	*Legumes sp.*	0	0	0	3.29	0	0	0	3.2	0	0	1.12

ربيان جبلي	*Leontodon tuberosus*	0	0	0	0	0	0	0	0	2.27	1.09	0
زوان	*Lolium sp*	0	0	0	1.09	3.19	3.12	0	0	0	4.35	0
دحريجة	*Medicago scutellata*	0	1.25	0	0	1.06	0	0	0	0	0	1.12
قرط	*Medicago sp*	0	0	0	0	0	0	0	0	0	2.18	0
حندقوق	*Melilotus indica*	0	0	1.27	0	0	0	0	0	0	0	0
أبو حربة زهري	*Minuartia decipiens*	0	0	0	0	0	0	0	0	0	1.09	0
خرفيش	*Notobasis syriaca*	0	0	0	0	1.06	0	2.35	3.45	0	1.09	0
جريس	*Onobrychis caput-galli*	0	0	0	0	0	0	0	0	1.14	5.53	0
شوكه زرقاء	*Onopordon sp.*	0	0	1.27	0	0	0	0	0	0	0	0
قديح، قدحة	*Phagnalon rupestre*	5.63	2.5	0	21.9	3.19	3.12	4.71	0	2.27	0	1.12
شعير الفار	*phalaris sp.*	0	0	0	0	0	2.08	0	0	1.14	3.26	3.37
ركاب الجمل	*Phomis kurdica*	0	0	0	0	0	0	0	0	1.41	0	0
سنام مكانس	*Piptatherum miliaceum*	0	0	1.27	0	0	2.08	2.35	0	0	0	0
قطونه	*Plantago afra*	0	0	0	0	0	0	0	0	0	0	1.12
لسان الحمل	*Plantago coronopus*	0	0	0	0	0	0	0	0	0	1.09	3.37
نزعة	*Poa bulbosa*	0	0	0	5.49	0	2.08	0	0	1.14	0	1.12
رويس	*Rhagadiolus stellatus*	0	0	0	0	5.32	1.04	0	0	0	0	0
لزيقة –دبيقة	*Rubia tenuifolia*	0	0	0	0	0	0	0	0	1.14	0	0
نتش	*Sarcopoterium spinosum*	39.44	50	41.77	34.06	26.6	28.12	22.35	24.14	28.41	20.65	19.1
عنجد	*Scorpiurus muricatus*	0	0	0	0	1.06	0	0	0	0	0	0
لفيته	*Sinapis arvensis*	0	0	0	2.19	1.06	0	0	2.3	0	0	0
علك خيل	*Sonchus oleraceus*	0	0	1.27	0	0	0	0	0	0	0	0
بهمة	*Stipa capensis*	0	0	0	0	2.13	0	1.18	0	0	0	1.12
جلثون	*Tetragonolobus palaestinus*	0	0	0	1.09	0	0	0	0	0	0	0
جعدة	*Teucrium capitatum*	1.41	0	2.35	1.09	4.26	0	8.23	2.3	2.27	0	3.37
جزر الشيطان	*Torilis tenella*	0	0	0	0	0	1.04	0	0	0	1.09	1.12
قرط أصفر	*Trifolium campestre*	0	0	0	0	0	0	0	0	0	1.09	0
قرط بنفسجي	*Trifolium resupinatum*	0	0	0	0	0	0	0	0	0	1.09	1.12
	Trifolium sp.	0	0	0	0	1.06	5.2	0	8.05	5.68	1.09	6.74
حواجة	*Trigonella stellata*	0	0	0	0	0	0	0	0	0	1.09	0
بصيل	*Urginea maritima*	0	0	0	0	0	0	1.18	0	1.14	0	0
قضيد	*Urospermum picroides*	0	0	0	0	0	0	2.35	0	0	0	0
كتيلة	*Varthemia iphionoides*	0	2.5	0	1.09	1.06	1.04	1.18	0	0	0	1.12
	Total	100	100	99.83	99.89	99.62	99.93	100	100.9	100.3	99.78	99.95

Table (3) Change in vegetation cover percent at Dura study site during 2004, 2005

Dura		2004						2005				
Arabic Name	**Scientific name**	19.1	9.2	1.3	27.3	9.4	10.5	17.1	22.2	20.3	13.4	16.5
شعير بليس	*Aegilops sp.*	0	0	0	0	3.26	3.23	0	0	0	4.26	3.49
ختمية	*Alcea sp*	0	0	0	1.06	0	0	1.1	0	0	0	0
ثوم بري	*Allium sp.*	0	0	0	0	0	2.15	0	1.09	0	0	0
عين الجمل	*Anagallis arvensis*	0	0	0	0	0	0	0	0	0	1.06	0
حمحم	*Anchusa sp.*	0	0	0	2.13	1.09	0	0	0	2.25	2.13	1.16
اقحوان	*Anthemis sp.*	0	0	6.1	11.7	2.17	0	6.59	7.61	9.11	5.32	1.16
غيصلان	*Asphodelus aestivus*	16.95	14.08	8.54	4.26	4.35	6.45	6.59	8.7	5.62	2.13	4.65
أم خرس	*Atractylis cancellata*	0	0	0	0	1.09	0	0	0	1.12	2.13	0
شوفان	*Avena sterilis*	18.64	0	7.32	15.96	11.96	15.05	0	9.78	11.36	5.32	13.95
رغيف الراعي	*Biscutella didyma*	0	0	0	0	0	0	0	1.09	1.12	0	0
دنبان	*Brachypodium distachyon*	0	0	0	0	5.43	0	0	0	0	1.06	4.65
ثرغول	*Bromus sp.*	0	0	0	0	0	0	0	1.09	3.37	3.19	0
شوكة حمار	*Carlina curetum*	0	0	1.22	0	0	0	0	0	0	0	0
قوص	*Carthamus tenuis*	0	0	0	0	0	1.09	0	0	0	3.19	3.49
بسباس	*Chrysanthemum segetum*	0	0	0	2.13	0	0	0	0	0	0	0
علك	*Cichorium pumilum*	0	0	0	0	0	0	0	0	0	0	1.16
مدادة	*Convolvulus sp.*	0	0	0	0	1.09	1.08	0	0	0	0	0
صفيرة	*Crepis aspera*	0	0	1.22	3.19	4.35	0	0	4.35	4.49	5.32	3.49
كروبينيا	*Crupina crupinastrum*	0	0	0	0	0	8.6	0	3.26	0	4.26	9.3
قرن غزال	*Cyclamen persicum*	3.39	5.63	2.44	2.13	0	0	3.3	0	4.49	1.06	0
ارث	*Echinops polyceras*	0	p	0	0	0	1.08	0	0	1.12	0	1.16
إبرة العجوز	*Erodium acaule*	3.39	2.82	0	0	5.43	0	1.1	0	0	0	0
ابرة العجوز الكبيرة	*Erodium gruinum*	10.17	1.41	7.32	9.57	1.09	1.08	8.79	4.35	2.25	1.06	0
قرصعنة	*Eryngium creticum*	0	1.41	1.22	0	5.43	0	0	0	0	0	2.33
قطينة	*Evax contracta*	0	0	0	0	0	0	0	3.26	0	1.06	0
	Forbs	0	0	0	0	1.09	0	0	0	0	1.06	0
اعشاب	*Grasses*	1.69	2.82	0	0	0	6.45	9.89	7.61	4.49	0	4.65
عكوب	*Gundelia tournefortii*	0	0	1.22	0	0	0	0	0	0	0	0
رويس الجبل	*Hedypnois cretica*	0	0	0	0	0	0	0	0	0	1.06	1.16
ورد الشمس / اصفر	*Helianthemum lippii*	0	0	0	0	1.09	3.23	3.3	3.26	1.12	0	0
جريت –عدسيه	*Helianthemum salicifolium*	0	0	0	0	1.09	0	0	4.35	1.12	3.19	5.81
ورد الشمس ، احمر	*Helianthemum vesicarium*	0	0	0	0	0	0	0	0	3.37	1.06	0
غبيرة	*Heliotropium arbainense*	0	0	0	0	3.26	0	4.4	3.26	0	0	0
شعير بري	*Hordeum spontaneum*	0	23.94	17.07	3.19	0	0	10.99	0	0	0	0
ربحلة	*Lactuca orientalis*	0	0	0	0	0	2.15	0	0	0	0	0

خس بري	*Lactuca sp*	0	0	2.44	0	0	0	4.4	3.26	0	0	0
سعيسعة	*Lathyrus cicera*	0	0	0	4.26	0	0	5.49	1.09	1.12	1.06	0
بقوليات	*Legumes sp.*	0	0	3.66	0	0	0	3.3	6.52	0	0	1.16
زوان	*Lolium sp*	0	0	0	0	1.09	0	0	0	0	2.13	0
ركيبة	*Lomelosia palaestina*	0	0	0	0	1.09	1.08	0	0	1.12	4.26	1.16
دريهمة	*Malabaila secaul*	0	0	0	0	3.26	2.15	0	0	1.12	3.19	1.16
قرط	*Medicago sp*	0	0	0	1.06	0	0	0	1.09	0	4.26	1.16
عصا هرمس	*Mercurialis annue*	0	0	0	0	1.09	0	0	0	3.37	0	0
خرفيش	*Notobasis syriaca*	0	1.41	0	3.19	1.09	0	0	1.09	1.12	0	0
جريس	*Onobrychis caput-galli*	0	0	0	0	0	0	0	0	3.37	5.32	0
وسبة صقلية	*Ononis sicula*	0	0	0	0	1.09	0	0	0	0	2.13	0
بخور مريم	*Pallenis spinosa*	0	0	0	0	1.09	2.15	0	0	1.12	2.13	0
قديح، قدحة	*Phagnalon rupestre*	0	0	4.88	3.19	7.61	3.23	1.1	2.17	2.25	1.06	2.33
شعير الفار	*phalaris sp.*	0	0	0	0	2.17	2.15	0	0	0	1.06	2.33
سنام مكانس	*Piptatherum miliaceum*	6.78	5.63	6.1	4.26	0	9.68	3.3	3.26	5.62	2.13	3.49
قطونه	*Plantago afra*	0	0	0	0	2.17	0	0	0	0	1.06	0
نزعة	*Poa bulbosa*	0	0	0	0	0	0	0	0	0	0	0
رويس	*Rhagadiolus stellatus*	0	0	0	0	1.09		0	0	2.25	1.06	2.33
حميض	*Rumex sp.*	0	0	0	0	0	1.09	0	0	0	1.06	0
خوخ بري	*Salvia syriaca*	3.39	1.41	0	5.32	11.96	0	2.2	0	1.12	0	0
نتش	*Sarcopoterium spinosum*	28.81	25.35	19.51	12.77	0	0	12.09	10.87	6.74	5.32	6.98
خردل	*Sinapis alba*	0	0	0	0	0	12.9	0	0	0	2.13	0
لفيته	*Sinapis arvensis*	0	7.04	3.66	1.06	0	0	2.2	2.17	2.25	1.06	2.33
بهمة	*Stipa capensis*	0	0	1.22	3.19	0	0	0	0	0	5.32	1.16
جلثون	*Tetragonolobus palaestinus*	0	0	0	1.06	2.17	0	0	0	0	0	0
جعدة	*Teucrium capitatum*	0	0	4.88	3.19	2.17	0	4.4	3.26	2.25	0	1.16
جزر الشيطان	*Torilis tenella*	0	0	0	0	1.09	6.45	0	0	0	1.06	1.16
ذنب الفرس	*Tragopogon coelesyriacus*	0	0	0	0	0	0	0	0	2.25	0	0
قرط أصفر	*Trifolium campestre*	0	0	0	0	0	0	0	0	0	0	1.16
قرط بنفسجي	*Trifolium resupinatum*	0	0	0	0	2.17	0	0	0	0	0	1.16
	Trifolium sp.	0	0	0	0	0	0	0	1.09	4.49	2.13	4.65
حواجه	*Trigonella stellata*	0	0	0	0	1.09	2.15	0	0	0	1.06	0
غير معرف	*unkown*	0	0	0	0	3.26	0	0	0	0	0	1.16
كتيله	*Varthemia iphionoides*	6.78	7.04	0	2.13	0	5.38	5.49	1.09	2.25	1.06	2.33
	Total	9.99	99.99	100	100	100	100.1	100	100	100.2	99.79	99.98

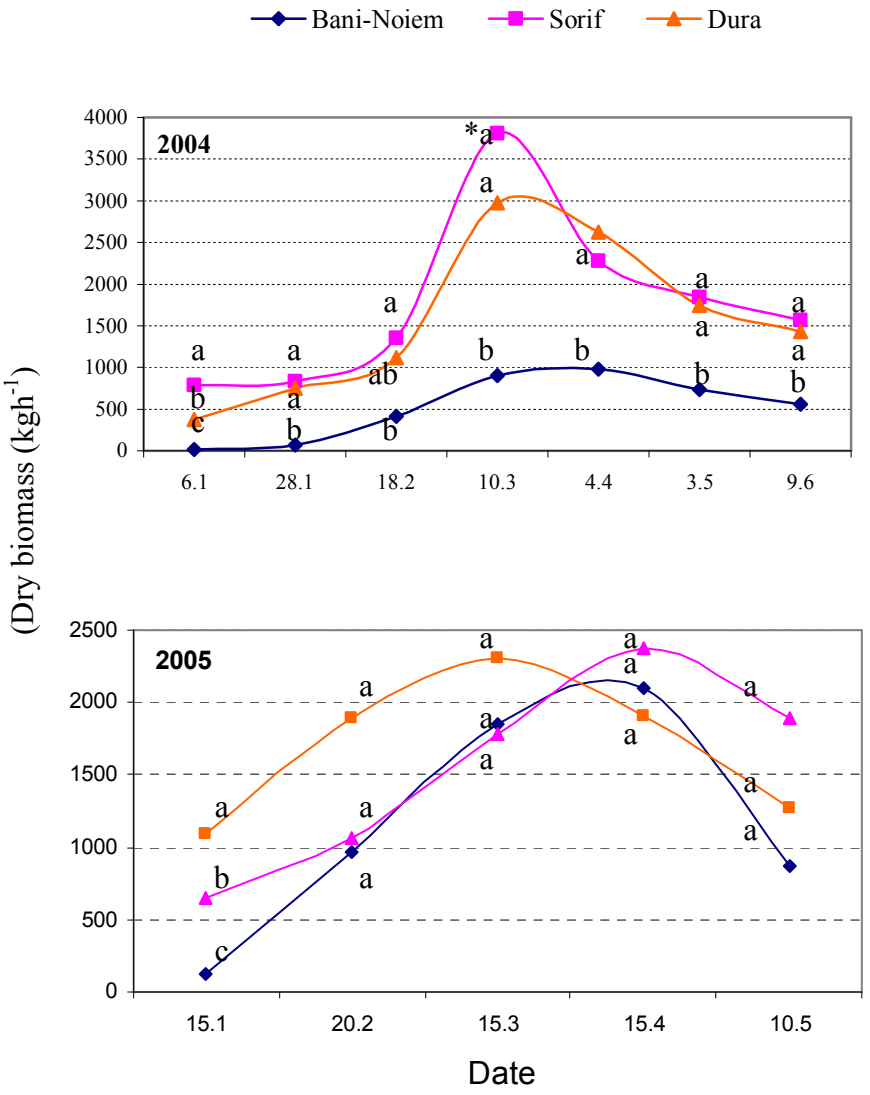


Figure (1) Rangeland Dry biomass (kg.ha-1) at Bani-Noeim, Sorif and Dura sites during 2004, 2005.

* Means followed with similar letters are not significantly different according to Fisher>s LSD at p ≤0.05.

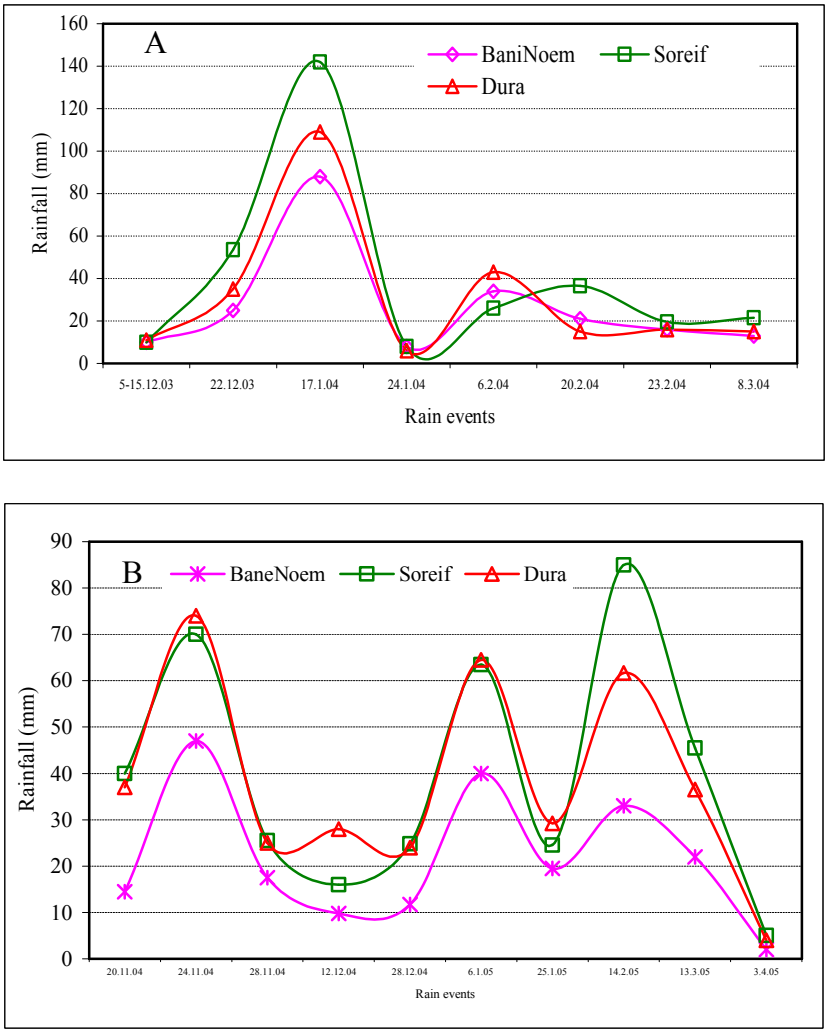


Fig (2): Amount of precipitation for the main rain events at Ban-Noem, Sorif and Dura during the year 2004 (A) and 2005 (B).

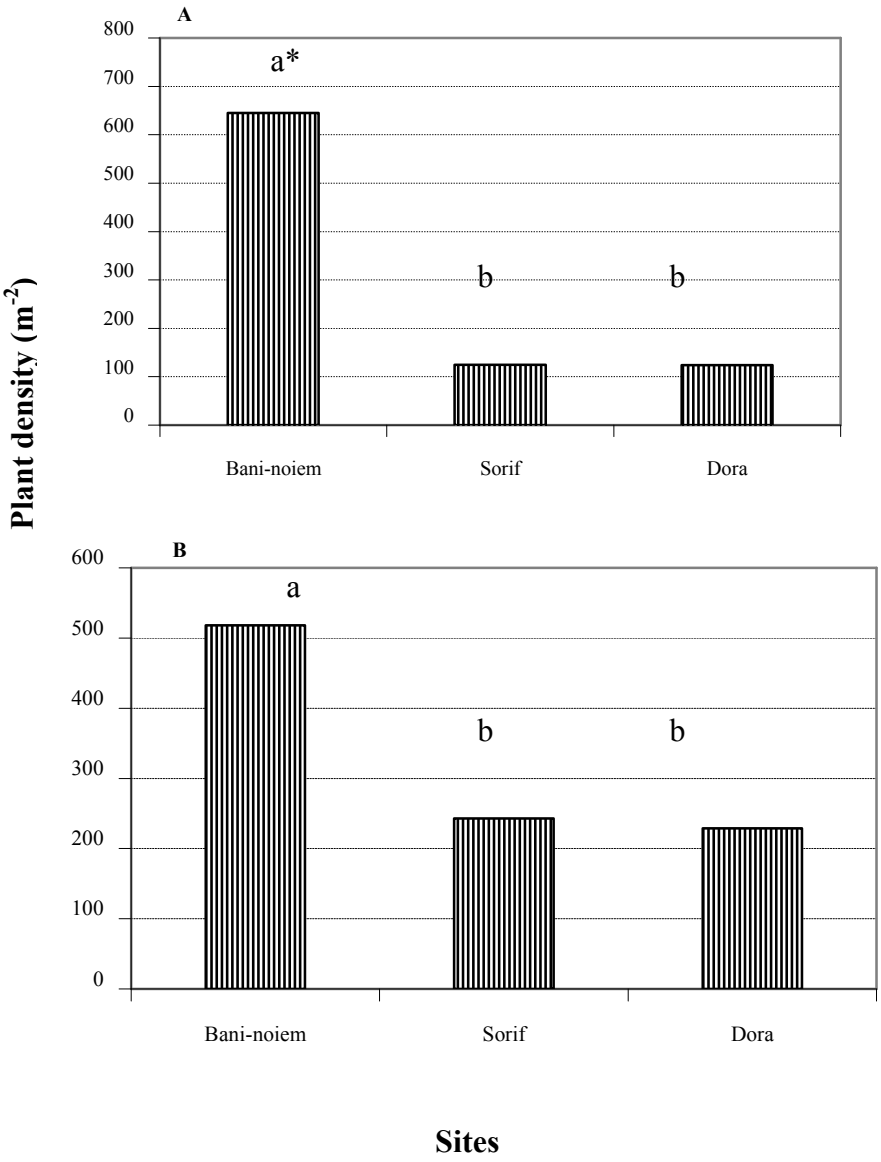


Figure (3) Average plant density in Bani-Noeim, Sorif and Dura sites during the peak growth stage of 2004 (a), 2005(b).
* Means followed with similar letters are not significantly different according to Fisher>s LSD at $p \leq 0.05$.

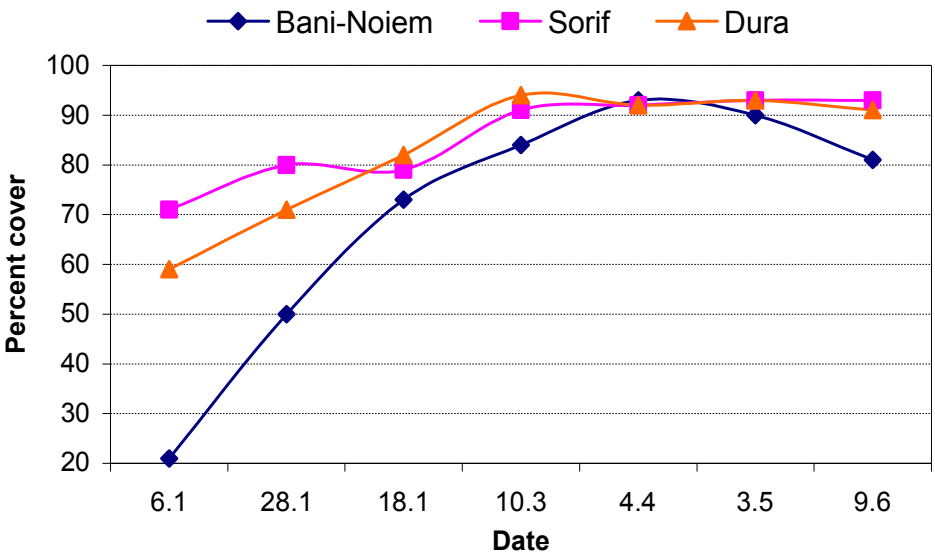
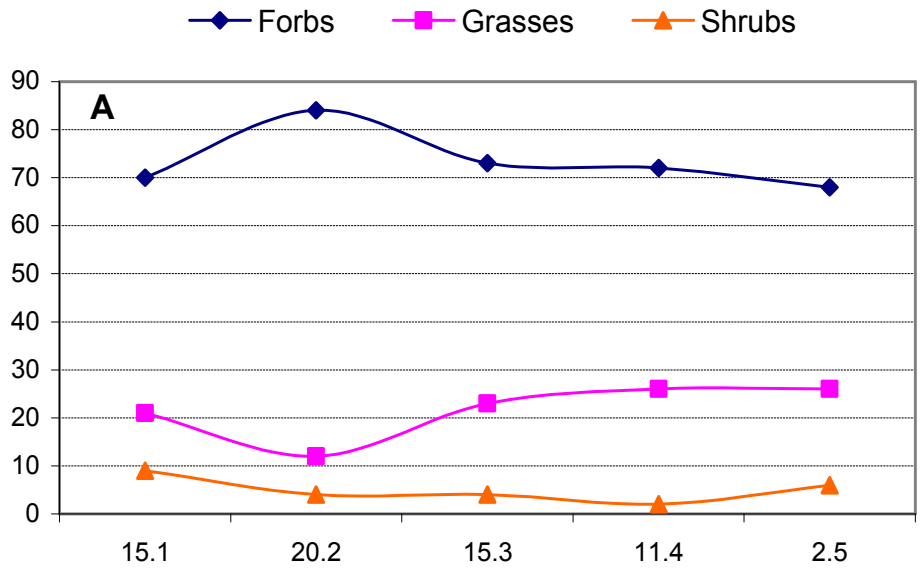


Figure (4) the development of vegetation cover at Bani-Noiem, Sorif, and Dura during 2004



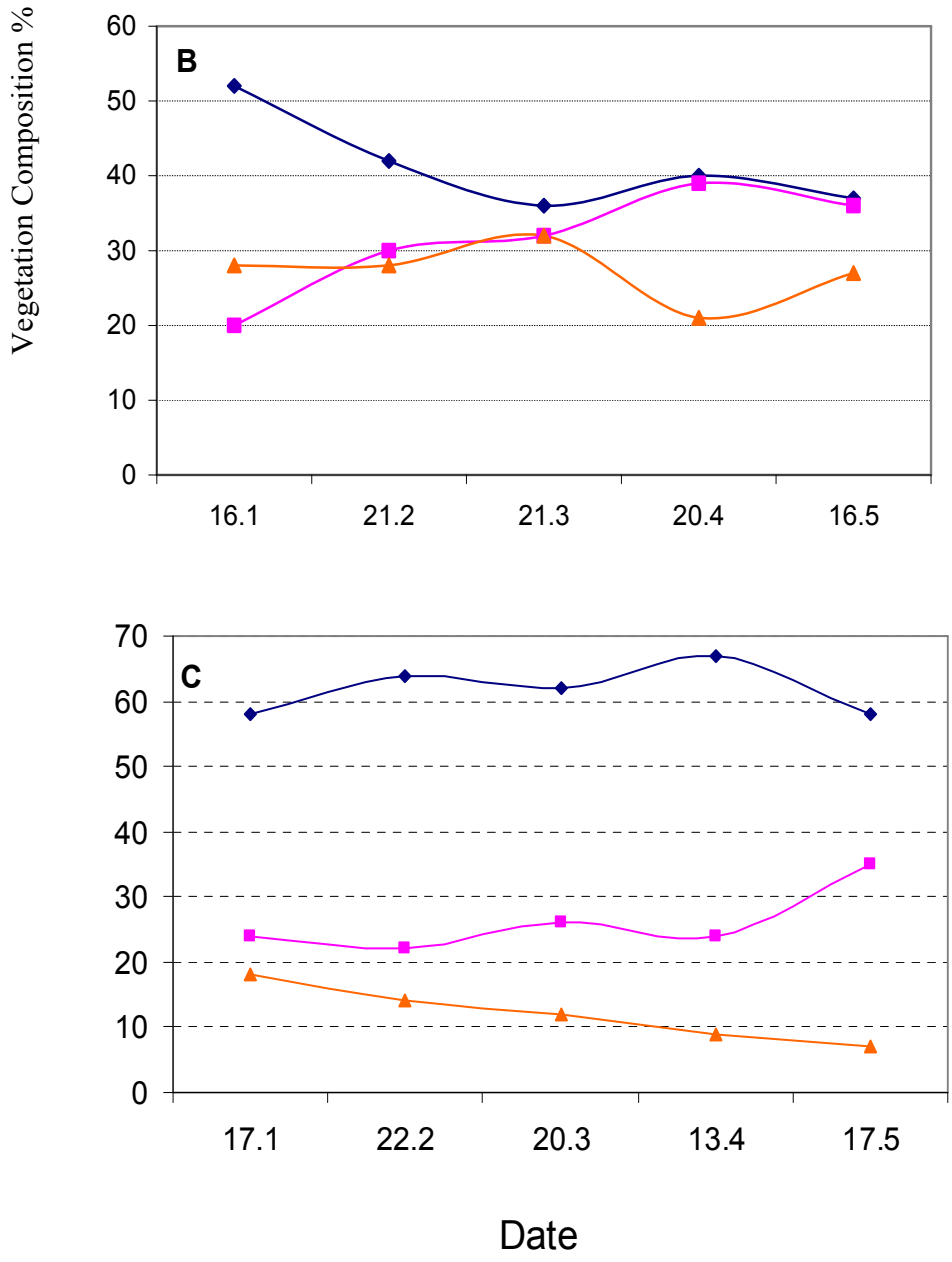


Figure (5) Vegetation composition at Bani-Noiem (A), Sorif (B), and Dura (C) during 2005