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THE ABILITY OF DROUGHT DECIDUOUS, EVERGREEN, AND SUCCULENT SPECIES TO SURVIVE DROUGHT, AND ITS POSSIBLE SIGNIFICANCE IN SUCCULENT DISTRIBUTION IN SOUTH AFRICA.

Ecology Project

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Botany Honours

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ABSTRACT

A comparison was made of the ability of drought deciduous, evergreen, and succulents to survive a drought. The plants were all subject to drought conditions and their relative photosynthetic rates were measured. The relative water content of each species and the percentage soil moisture was also measured. The deciduous species, *Acacia nigrescens*, shed its leaves after 6 weeks of drought. It did not recover after 17,5 weeks of drought. The evergreen species' photosynthetic rates declined with increasing drought. They all survived a drought of 9,5 weeks but were not alive after 17,5 weeks. When watered after 9,5 weeks an *Erica sp.* increased its photosynthetic rate. The photosynthetic rates of the succulents also decreased with the drought. However, they all showed an increase in dark CO_2 fixation with the drought. After 9,5 weeks of drought the three winter growing species viz. *Carpobrotus mellei*, *Crassula fasicularis*, and *Euphorbia mauritanica* were all dead. The other two species, *Aloe littoralis* and *Cotyledon orbiculata* which are summer growing species survived 17,5 weeks of drought. The ability of the succulents to survive drought when compared to the evergreen and deciduous species was used in suggesting a preliminary hypothesis to explain the distribution of succulents in South Africa.

1. INTRODUCTION

Plants in arid or semi-arid regions are subjected to irregular periods of drought between short intermittent wet periods. Mechanisms to withstand drought have evolved in two basic ways. The first is complete drought avoidance, i.e. the ephemerals, exemplified by annuals. These appear in active form during wet conditions and survive during the dry periods as inactive seeds. The second mechanism is drought tolerance and perennial plants have evolved a variety of specialised adaptations to enable them to survive drought conditions. Many of these are morphological adaptations e.g. reduction in surface area (Shields, 1950; Parker, 1968), succulence, 'rain roots' of succulents (Levitt, 1972) and deep roots of non-succulents (Cloudsley-Thompson, 1977). However, physiological adaptations are also important. One of the main physiological adaptations is in the development of an alternate photosynthetic pathway. For example, the C_4 photosynthetic pathway appears to be especially adapted for plants where water resources are not only scarce but limiting in time. Crassulacean Acid Metabolism (CAM) is also a mechanism which enables plants to survive in arid or semi-arid regions, but it has not received as much attention because it is not economically important. The majority of plants possessing CAM are succulents, although not all succulents are CAM plants (Kluge & Ting, 1978).

In this study an attempt was made to see if there was any significant difference in the ability of various perennial plants to survive drought. The plants used were drought deciduous, evergreen, and succulent species.

These plants were subjected to rigorous droughting and the photosynthetic rates of each species was studied. Although the study was artificial, as potted plants were used and the evergreen and drought deciduous species were without their deep roots, it was aimed at investigating each species ability to survive drought. This information gives the plant ecologist a better insight into being able to understand species distributions in relation to climatic patterns.

In areas of South Africa such as the Little Karoo succulents dominate (Acocks, 1953). They are also present in significant numbers along the west coast (succulent Karoo) and in parts of the Southern Cape (e.g. Spekboomveld and Noorsveld) and comprise an important part of the vegetation in other parts of South Africa (see Fig.1 and Acocks, 1953). The northern and eastern succulents are mainly *Euphorbia spp.* and *Aloe spp.*, whereas in the Karoo mesembryanthaceae are the most important. What is significant is that succulents are virtually absent from the Great Karoo and the Kalahari area. By studying the ability of succulents to survive drought, a preliminary hypothesis has been suggested to explain this unusual distribution.

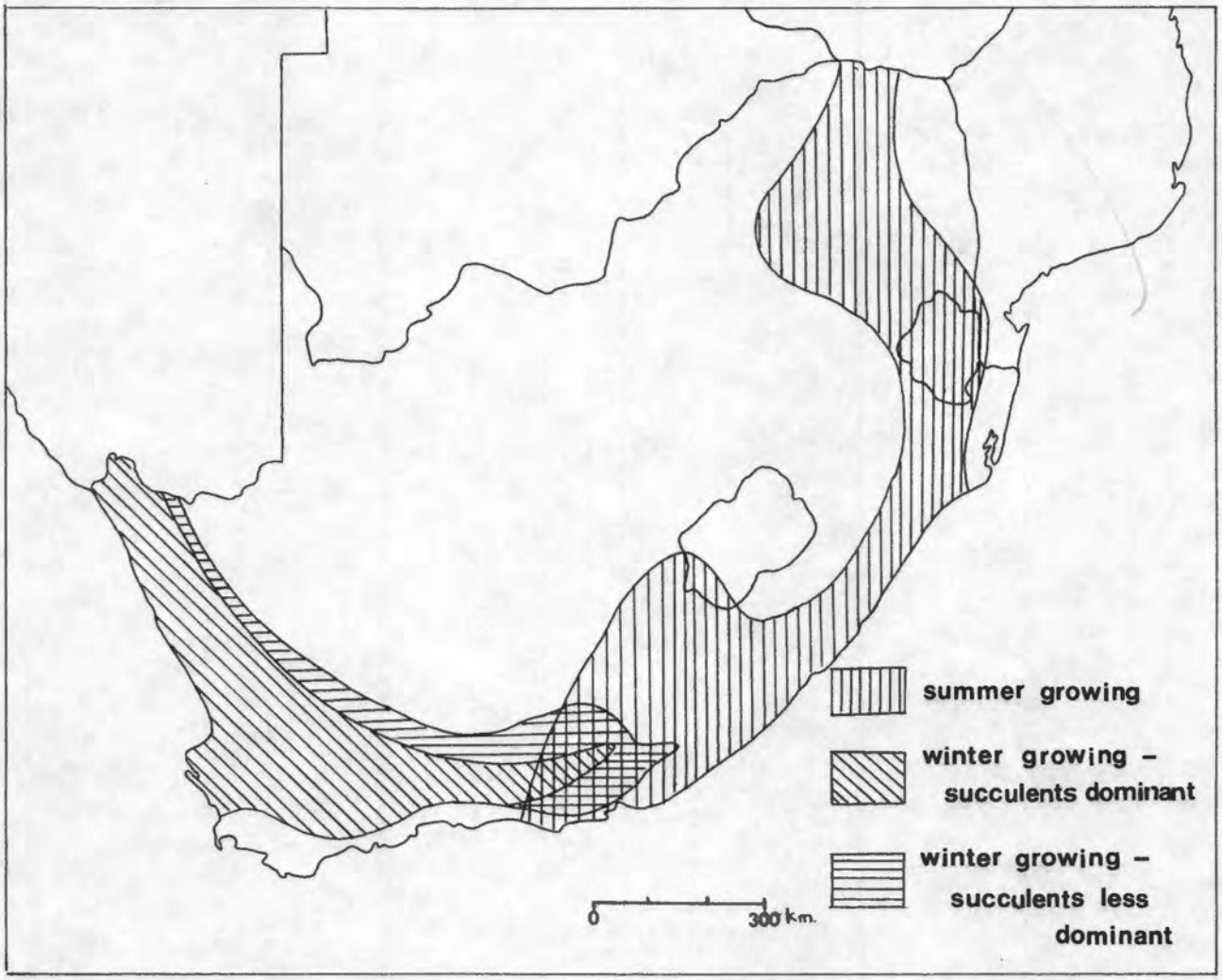

FIGURE 1:

Distribution of succulents in South Africa (van Jaarsveld pers Comm,).

2. MATERIAL AND METHODS

2.1. Plant Material and Growth Conditions

All the plants used were obtained from Kirstenbosch, and were in pots of varying size. (See Table 1 for a list of species and the volume of soil in the pots).

TABLE 1: SPECIES USED, THEIR 'CATEGORY OF ADAPTATION' AND VOLUME OF POTS

Species	Family	'Category of adaptation'	No.of Pots	Volume of soil (cm^3)
Acacia nigrescens	Mimosoideae	drought deciduous	2	1377,3
Erica sp	Ericaceae	evergreen	4	477,6
Euclea undulata	Ebenaceae	evergreen	4	431,8
Euryops condolei	Compositae	evergreen	2	415,5
Rhus lucida	Anacardiaceae	evergreen	2	934,9
Aloe littoralis	Liliaceae	succulent	3	517,4
Carpobrotus mellei	Aizoaceae	succulent	2	16742,3
Cotyledon orbiculata	Crassulaceae	succulent	3	2154,8
Crassula fasicularis	Crassulaceae	succulent	4	494,7
Euphorbia mauritanica	Euphorbiaceae	succulent	3	632,8

On the 12th April (Day 1) all the plants were placed in a growth room with a light intensity of 15 000 lux and a temperature range of 20 - 25° C. The plants were given an on-off light régime of 16 hours light and 8 hours dark. All the plants were watered every second day for two weeks (Day 12) after which they were no longer watered.

On the 5th June (Day 55) the plants were moved to a growth chamber with an on-off light regime of 14 hours light and 10 hours dark. The day temperature was 30° C and the night temperature 20° C. Light intensity was 30 000 lux and the relative humidity ± 50%. The plants were returned to the growth room on the 29 June and were watered on the 24 August.

2.2. Measurement of Photosynthetic Rates

The method used to measure the photosynthetic rates was modified from Vosnesenstii, Zalenstii, and Austin (1971). The relative rates were measured using $^{14}CO_2$. During each measurement part of the plant was enclosed in a plastic bag which was sealed. Each plastic bag held a glass vial containing 1 ml of 50 µCi $Na_2{}^{14}CO_3$. 1 ml of 10% lactic acid was then injected into the vial to release $^{14}CO_2$ and the hole sealed and photosynthesis was allowed to continue for exactly 30 minutes. Release of $^{14}CO_2$ was stopped by the addition of excess (± 2 ml) 4N KOH. Discs with diameters of 0,6 cm were then taken from the leaves of all species except for *Euphorbia mauritanica* where a 0,6 cm section of stem was taken, and for *Erica sp*, *Euryops condolei*, and *Crassula fasicularis* where two leaves were taken. Three or four replicates were taken for each species. These samples were placed in separate scintillation vials and 0,2 ml 60% perchloric acid and 0,4 ml 30% H_2O_2 were added. The vials were then placed in an oven

at 75° C for two hours to allow the substrate to dissolve. 5 ml of scintillation cocktail (Dimilume$^{(R)}$ - 30) was added to each sample. The samples were then placed in the Beckman Liquid Scintillation Counter and left to stand overnight. Each sample was then counted for 20 minutes. Four "blanks", i.e. vials with reagents and a leaf disc not exposed to $^{14}CO_2$ were, prepared and counted for each species. The results obtained for each species were then corrected using equation 1.

$$\text{C fixing efficiency} = \frac{\text{sample counts - blank counts}}{\text{(dry weight) (30 minutes)}} \times \frac{100}{\text{\% counting efficiency}} \qquad (1)$$

units = dpm (disintegrations per minute). milligram^{-1}. minute of exposure^{-1}.

The photosynthetic rates were measured at various intervals during the drought. The succulents were all shown to be CAM species and their dark CO_2 uptake was therefore also measured.

2.3. Relative Water Content (R.W.C.)

After each photosynthetic measurement the R.W.C. for each plant was measured. Discs with as large a diameter as possible were used. However, in *Erica sp*, *Euryops condolei*, and *Crassula fasicularis* individual leaves were used as they were too small to be punched. Sections of the stem were used for *Euphorbia mauritanica*. These discs were then weighed to give fresh weight (Wf). They were then floated

on water for 24 hours and reweighed to give saturated weight (W_s). The discs were then oven dried for 24 hours at 80° C and reweighed to give dry weight (W_d). The relative water content, which is the water content in percent at a given time related to the water content at full turgor, was then calculated using equation (2) (Catsky,1974).

$$R.W.C. = \frac{W_f - W_d}{W_s - W_d} \times 100 \quad \ldots \quad \ldots \quad (2)$$

Relative water content was used rather than just water content as it allows a better comparison between species which have different abilities to store water. There are many possible errors in the method used especially the edge injection error (Spomer, 1972). However, as only the trends were important and not the absolute values this was not corrected for. In addition relatively large amounts of plant material are required for accurate assessment and plant material for this experiment was strictly limited.

2.4. Percentage Soil Moisture

The percentage soil moisture was also determined after each measurement. Two soil samples were collected betwen 5 to 10 cm deep. These were then weighed and then oven-dried overnight at 80° C and then reweighed.

2.5. Statistical Tests

Standard deviations were worked out for the photosynthetic results but not for R.W.C. or percentage soil measure as only 2 samples were used for these. Students t-tests were used to test whether the initial and final photosynthetic rates differed significantly for each species. T-tests were also used to compare the initial rates of succulents (*Aloe littoralis* and *Euphorbia mauritanica*) with an example of an evergreen species (*Erica sp.*) and with *Acacia nigrescens*, a deciduous species. More tests were not carried out as sample sizes were necessarily small, as most of the plants were young and small. Therefore, to enable the experiment to run for as long a period of time as possible, only a small number of leaves were used at each reading.

3. RESULTS

After 9,5 weeks of drought (day 79) the only species which appeared dead were *Euphorbia mauritanica, Crassula fasicularis, Carpobrotus mellei,* and one of the *Rhus lucida* plants. *Acacia nigrescens* had shed all its leaves. The evergreen species, although no longer photosynthesising were still green as was *Aloe littoralis* and *Cotyledon orbiculata*. One of *Erica sp.* plant which was watered on day 74 recovered and started photosynthesising. The other plants were left for another 8 weeks (day 135) and then watered . The only plants that survived a total of 17,5 weeks of drought were *Cotyledon orbiculata* and *Aloe littoralis*.

3.1. Photosynthetic Rates

Acacia nigrescens the only deciduous species showed a rapid decrease in its photosynthetic rate and after 6 weeks of drought started shedding its leaves (see Fig.2). Its photosynthetic rates, when not under drought was significantly different from the evergreen species at the 5% level, whereas it was significantly different from the photosynthetic rate and the dark CO_2 fixation rate of the succulents at the 1% level. After 6 weeks of drought when it started dropping its leaves, its photosynthetic rate was not significantly different from the light rate of the succulents, but was significantly different at the 1% level from the dark rate

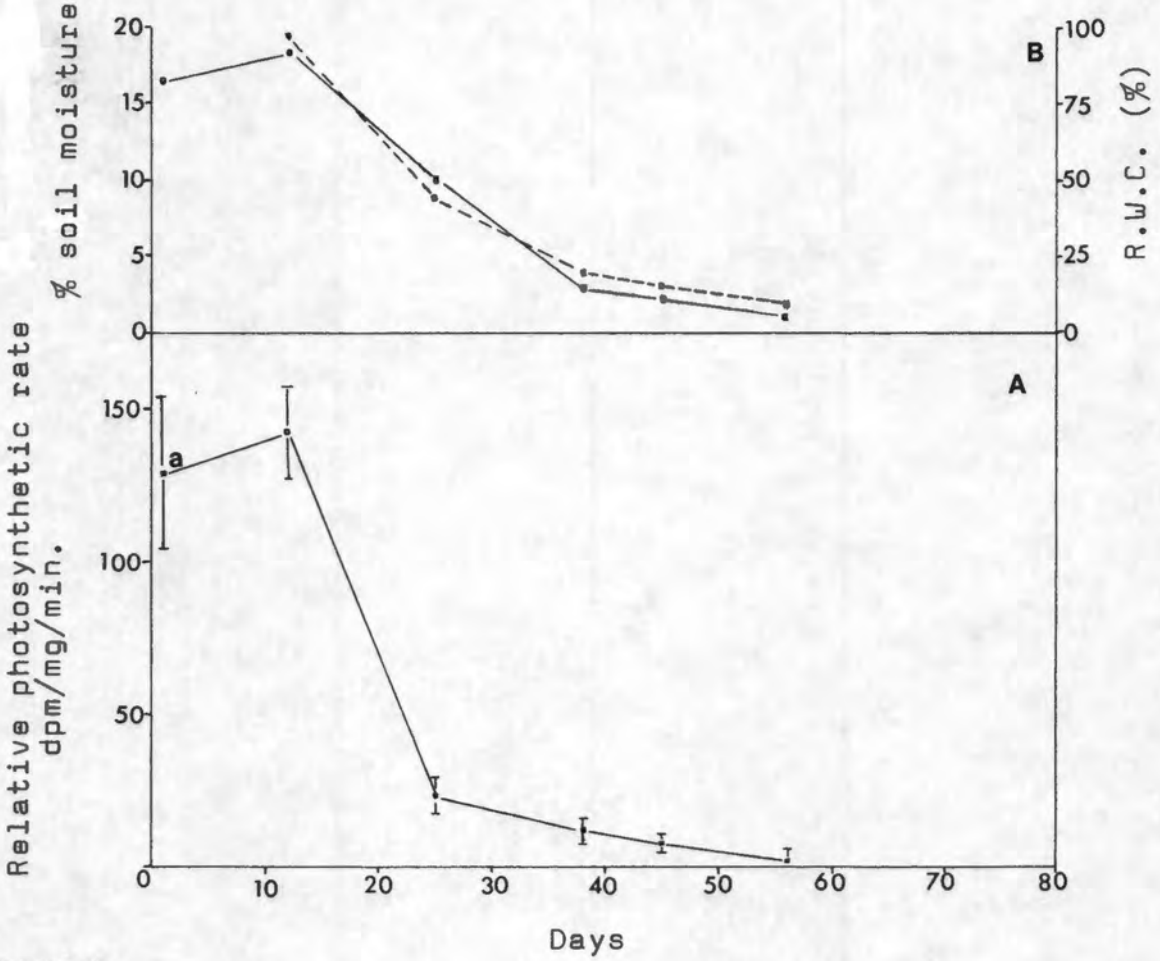

FIGURE 2:

A. Relative photosynthetic rate of *Acacia nigrescens* with increasing drought. (a, indicates significantly different from final reading at 1% level)

B. Percentage soil moisture (•————•), and relative water content (R.W.C.) (• ------ •) of *A. nigrescens*. (Last watered on day 12)

of CO_2 fixation of the succulents and from the evergreen species. This species did not recover after 17,5 weeks of drought.

In all the evergreen species the CO_2 uptake can be seen to decrease with increasing water stress (see Figs.3 - 6). Although the decrease in rates varied in the different species, all of them after 6 weeks of drought had relatively low photosynthetic rates. *Euclea undulata* was the only evergreen species to have a significantly (5% level) different photosynthetic rate from the other evergreen species when the plants were not under any stress. Its highest rate was 224,37 dpm mg^{-1} m^{-1}, whereas the rates of the other three species on the same day were in the range 339,55 - 437,94 dpm mg^{-1} m^{-1}.

The succulent species had very low photosynthetic rates even when not subjected to any water stress (see Figs.7 - 11). The photosynthesis decreased with increasing water stress in all 5 species, until a point after 6 - 8 weeks where no significant amounts of photosynthesis occured. All five species were shown to be CAM plants. With the possible exception of *Crassula fasicularis* the succulents all seem to be induciable CAM species. When they were not under any water stress they appeared to have no measurable amounts of CO_2 uptake during the dark period. However, once the plants were water-stressed and the light photosynthesis decreased, then the dark rate of CO_2 uptake increased.

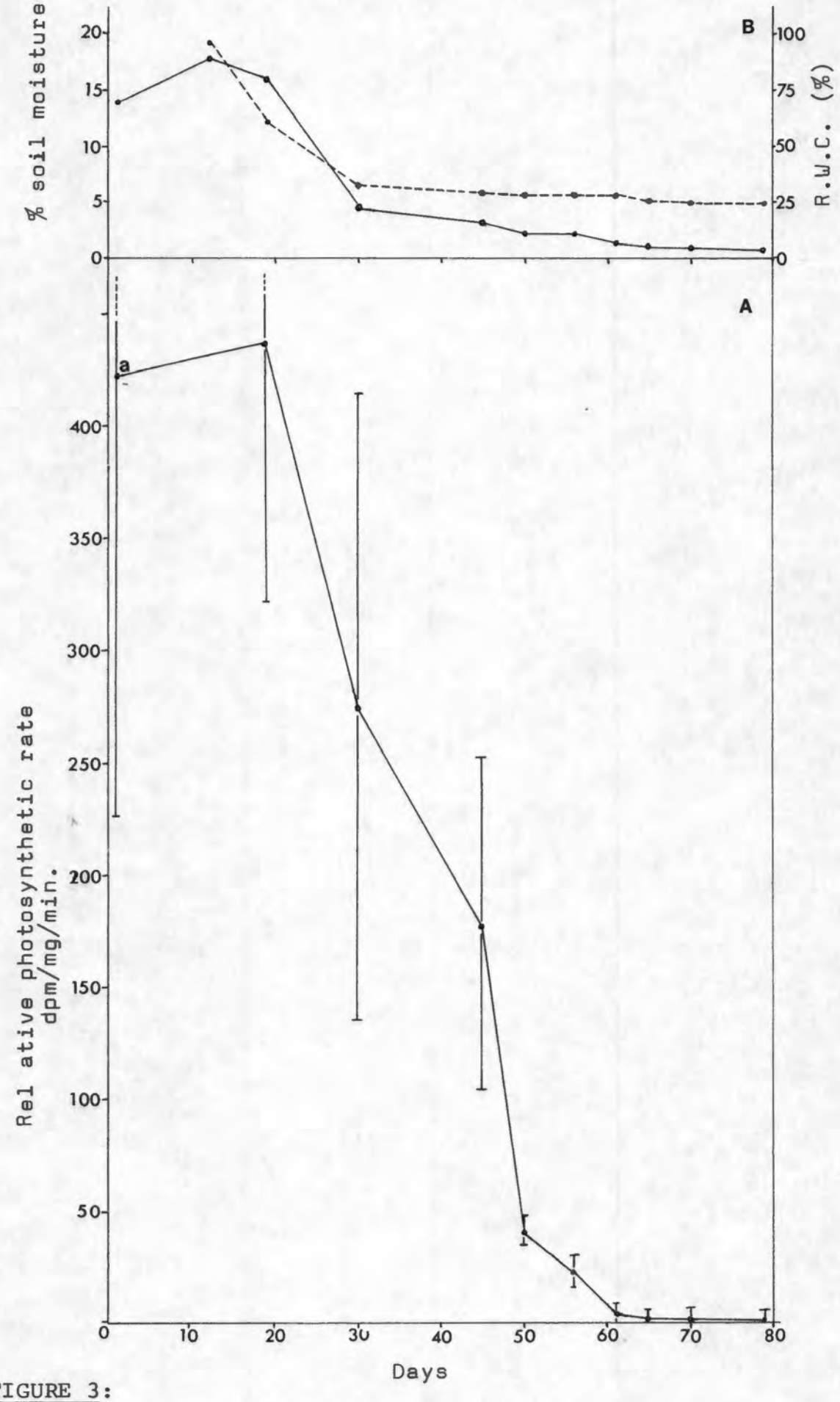

FIGURE 3:

A. Relative Photosynthetic Rate of *Erica sp* with increasing drought. (a, indicates significantly different from final reading at 1% level)

B. Percentage Soil Moisture (•————•) and Relative water content R.W.C) (•----------•) of *Erica sp.*

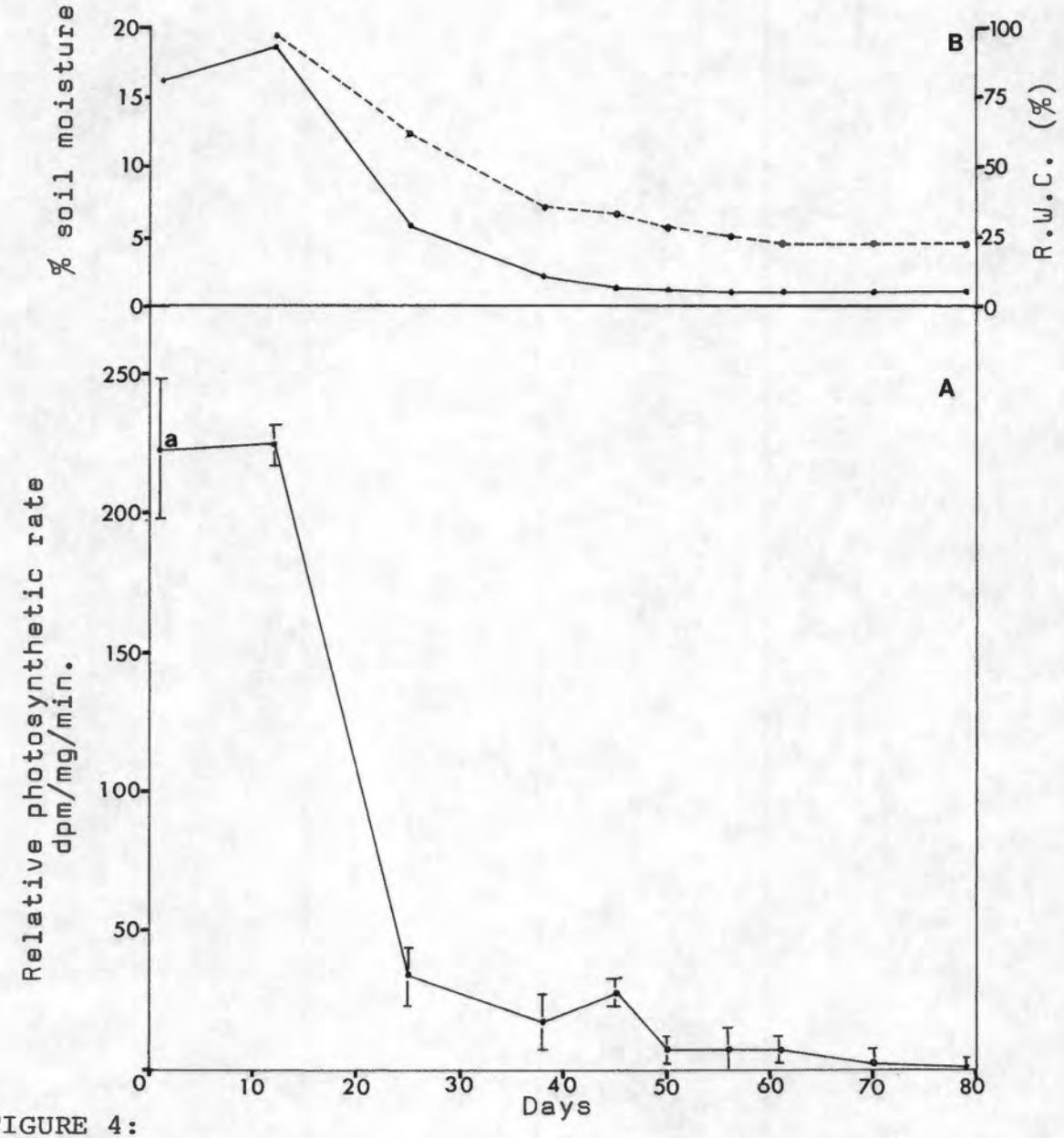

FIGURE 4:

A. Relative photosynthetic rate of *Euclea undulata* with increasing drought. (a, indicates significantly different from final reading at 1% level)

B. Percentage Soil Moisture (•———— •) and relative water content (R.W.C.) (•-------•) of *E. undulata*. (Last watered on day 12)

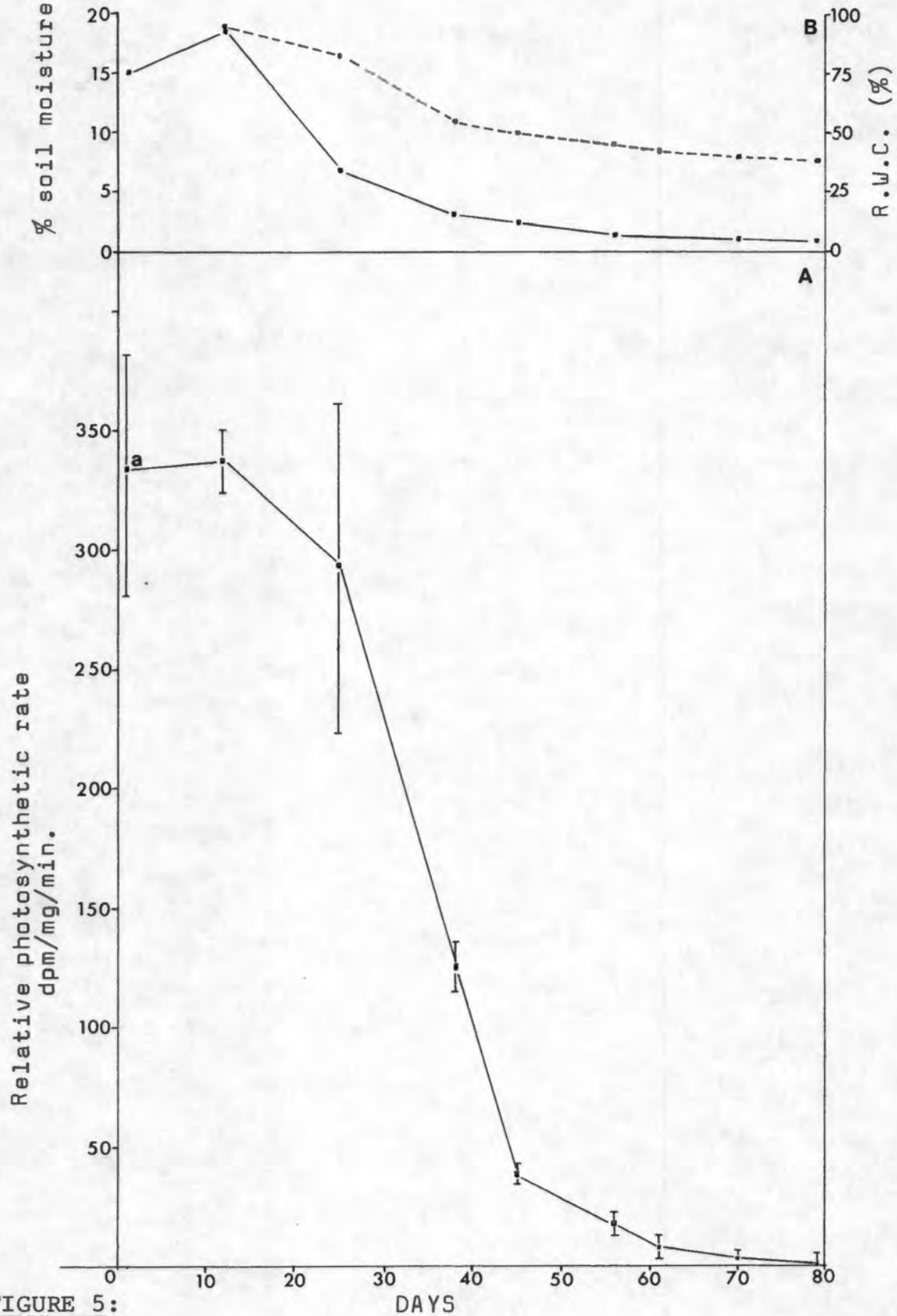

FIGURE 5:

A. Relative photosynthetic rate of *Euryops condolei* with increasing drought. (a,indicates significantly different from final reading at 1% level)

B. Percentage Soil Moisture (•———•) and relative water content (R.W.C.) (•-------•) of *E. condelei*. (Last watered on day 12)

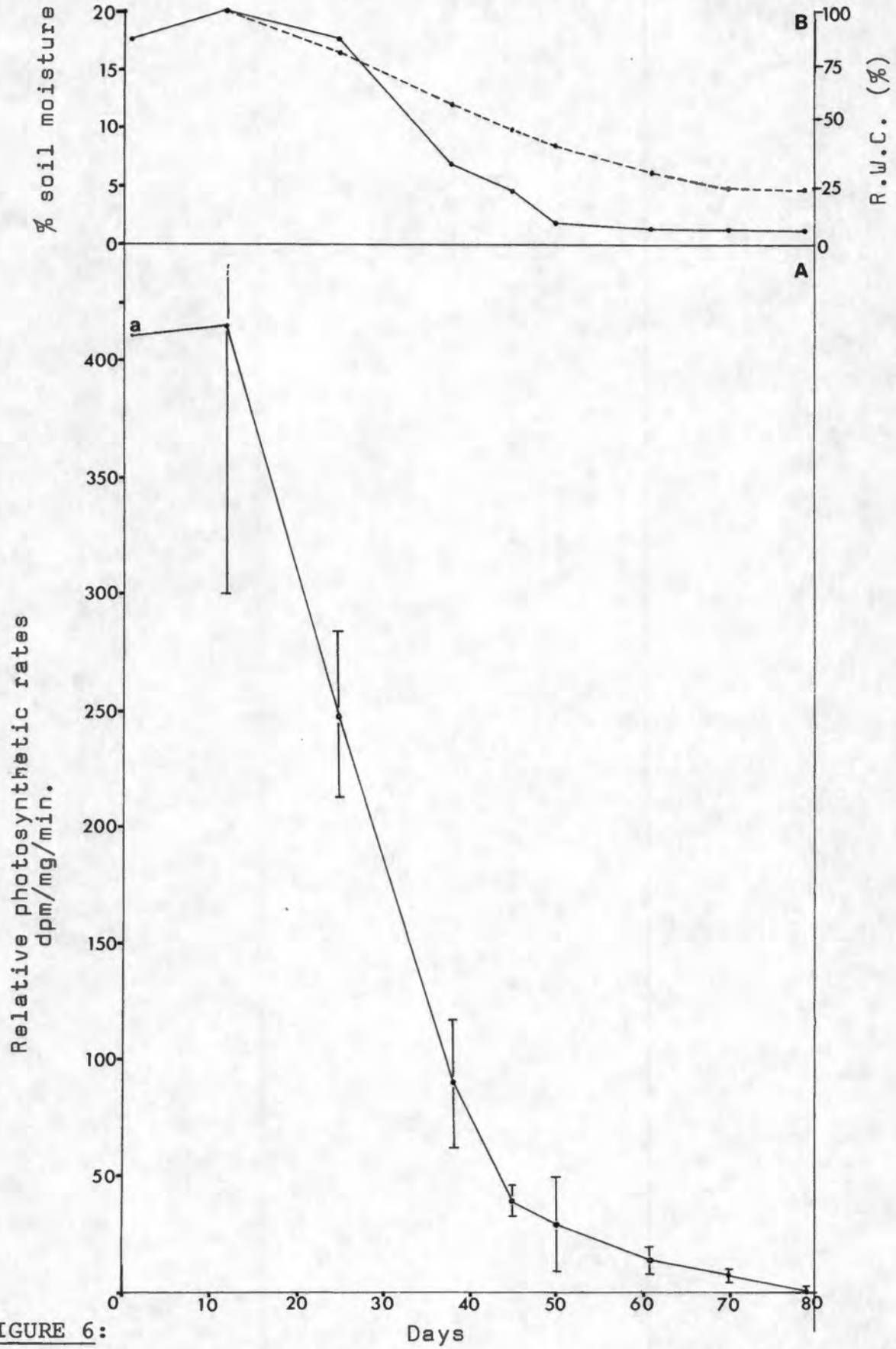

FIGURE 6:

A. Relative photosynthetic rate of *Rhus lucida* with increasing drought. (a., indicates significantly different from final reading at 1% level)

B. Percentage soil moisture (•——•) and relative water content (•-------•) of *R. lucida*.
(Last watered on day 12)

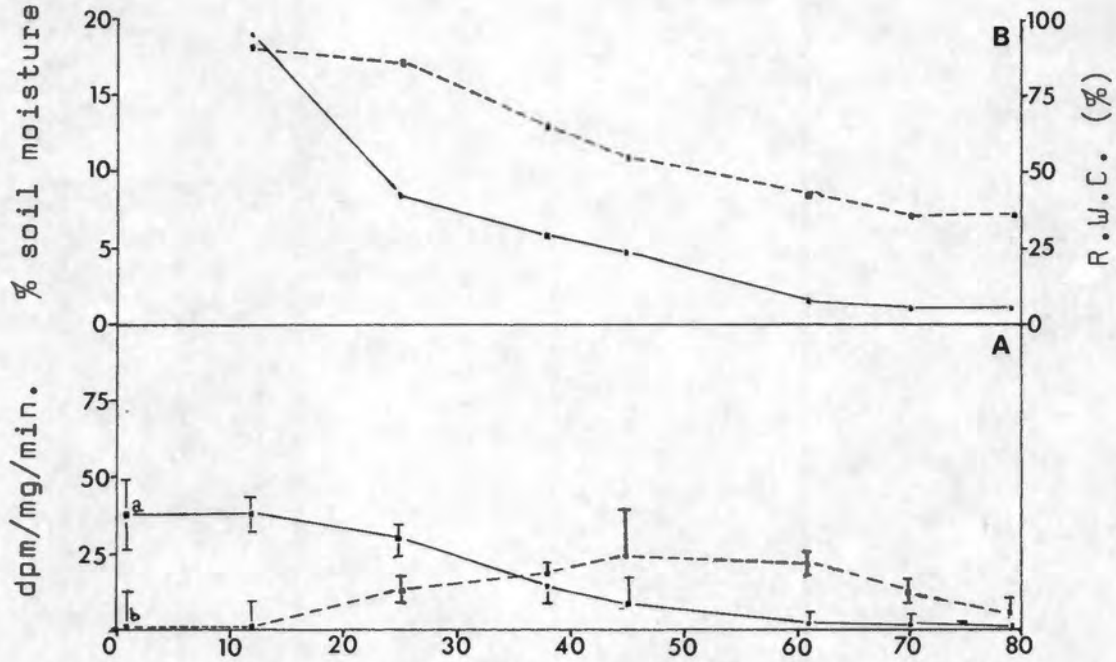

FIGURE 7:

A. Relative photosynthetic rate (•———•) and dark CO_2 fixation of (•-------•) of *Aloe littoralis* with increasing drought (a,b, significantly different from final reading (day 79) at 1% and 5% levels respectively.

B. Percentage soil moisture (•———•) and relative water content (R.W.C.) of *A. lottoralis*.
(Last watered on day 12)

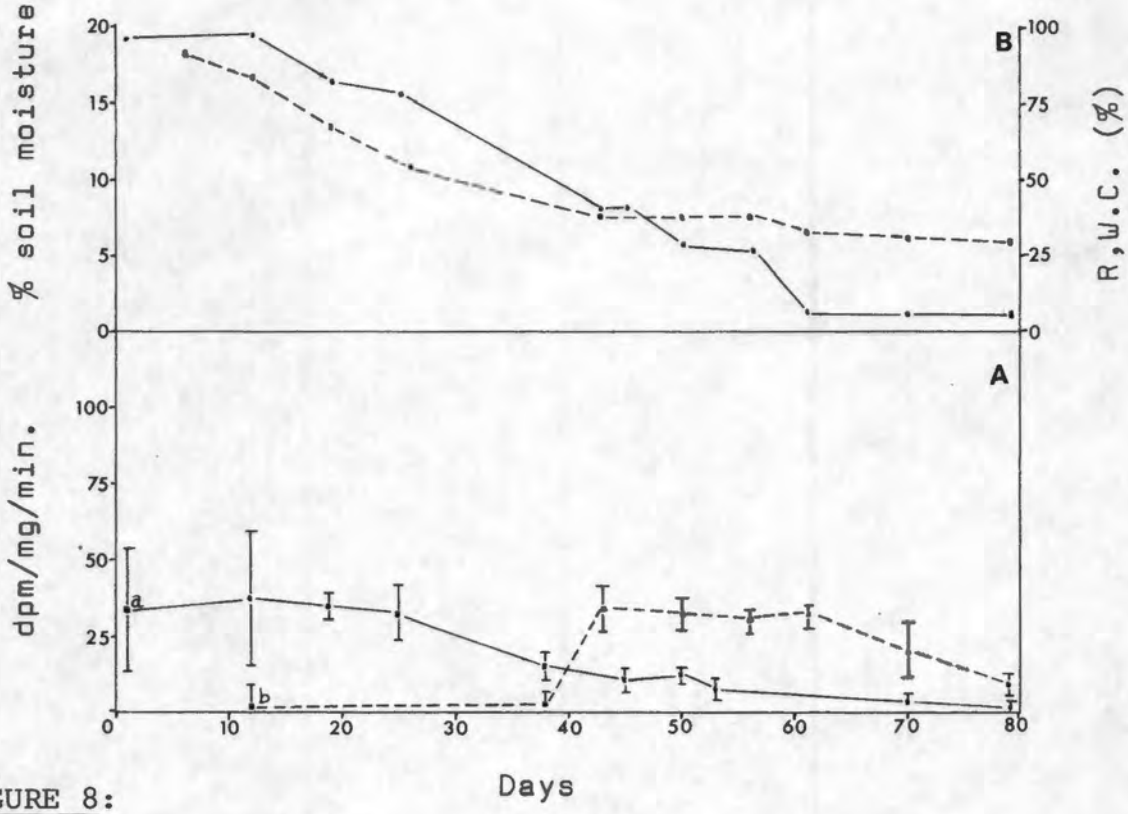

FIGURE 8:

A. Relative photosynthetic rate (•———•) and dark CO_2 fixation (•-------•) of *Cotyledon arbiculata* with increasing drought, (a,b, significantly different from final reading (day 79) at the 1% and 5% levels respectively).

B. Percentage soil moisture (•———•) and relative water content (R.W.C.) (•-------•) of *C. orbiculata*. (Last watered on day 12)

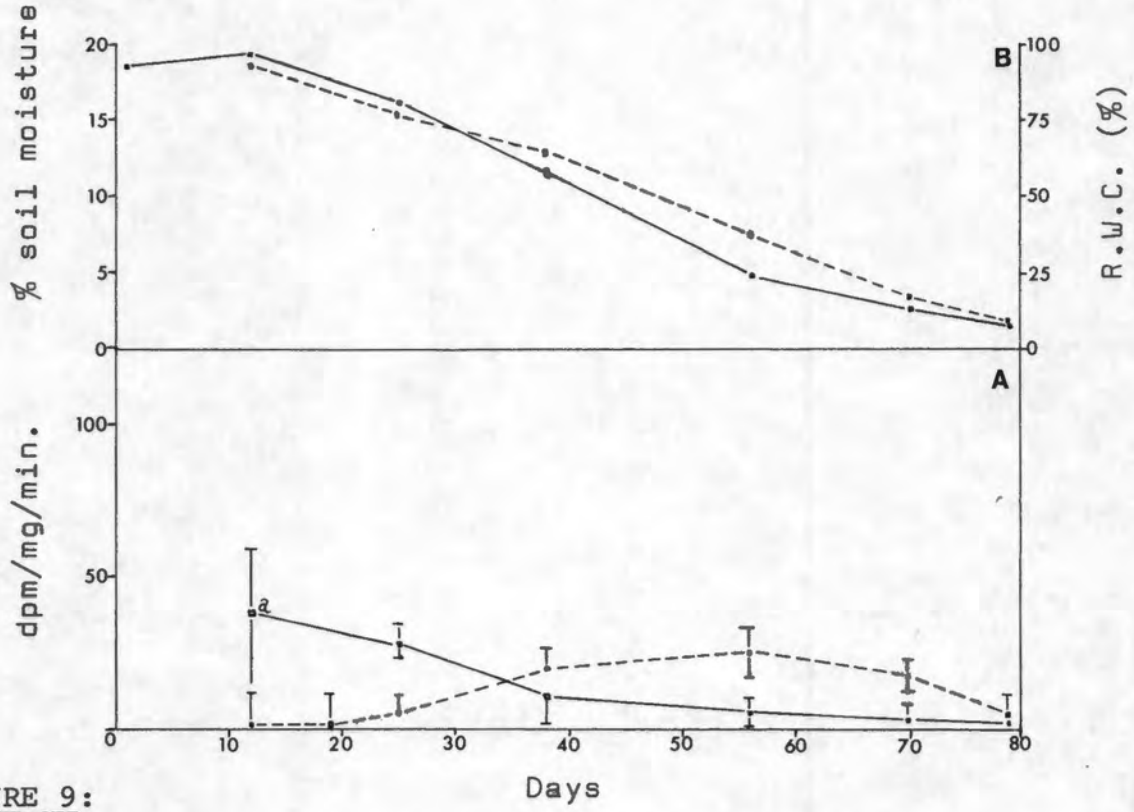

FIGURE 9:

A. Relative photosynthetic (•———•) and dark CO_2 fixation (•-------•) of *Carpobrotus mellei* with increasing drought. (a, significantly different from final reading (day 79) at 1% level)

B. Percentage soil moisture (•———•) and relative water content (R.W.C.) (•-------•) of *C. mellei*. (Last watered on day 12)

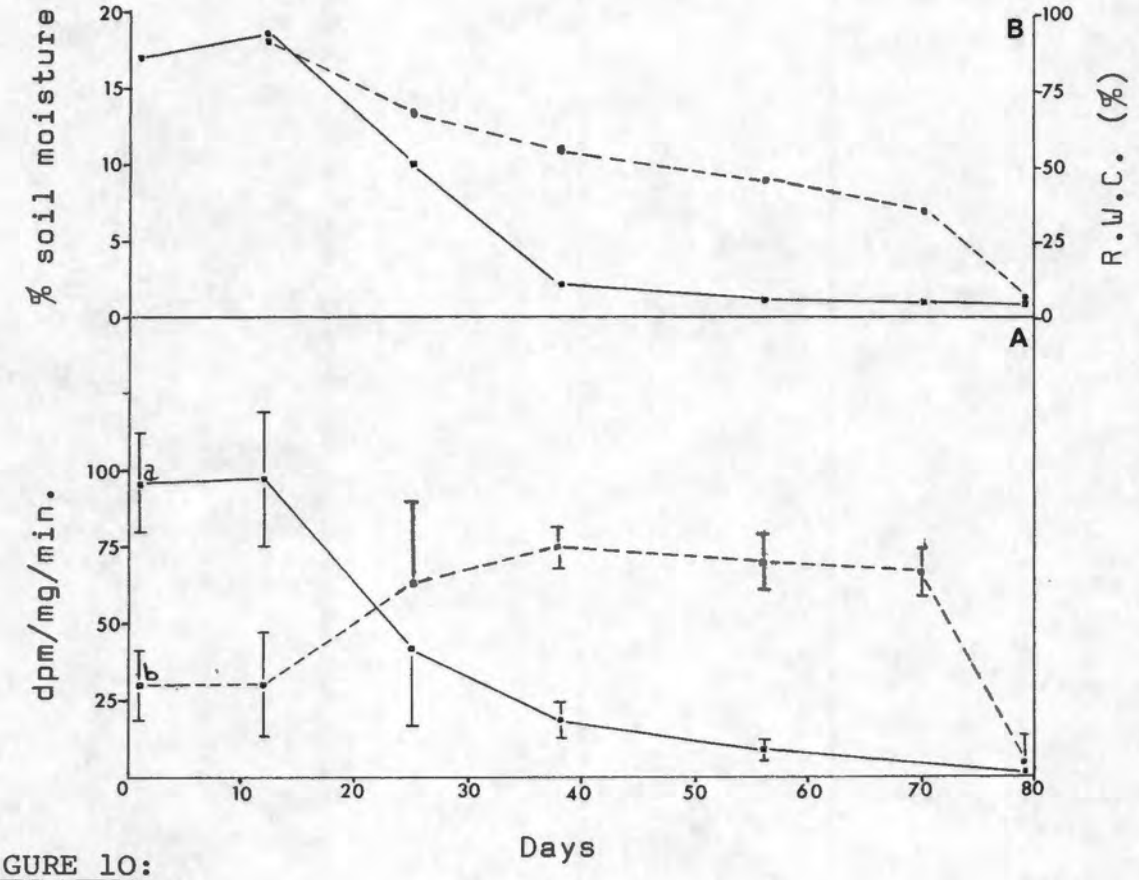

FIGURE 10:

A. Relative photosynthetic rate (•————•) and dark CO_2 fixation (•-------•) of *Crassula fasicularis* with increasing drought. (a,b significantly different from final reading (day 79) at the 1% and 5% levels respectively).

B. Percentage soil moisture (•————•) and relative water content (R.W.C.) of *C. fasicularis*. (Last watered on day 12)

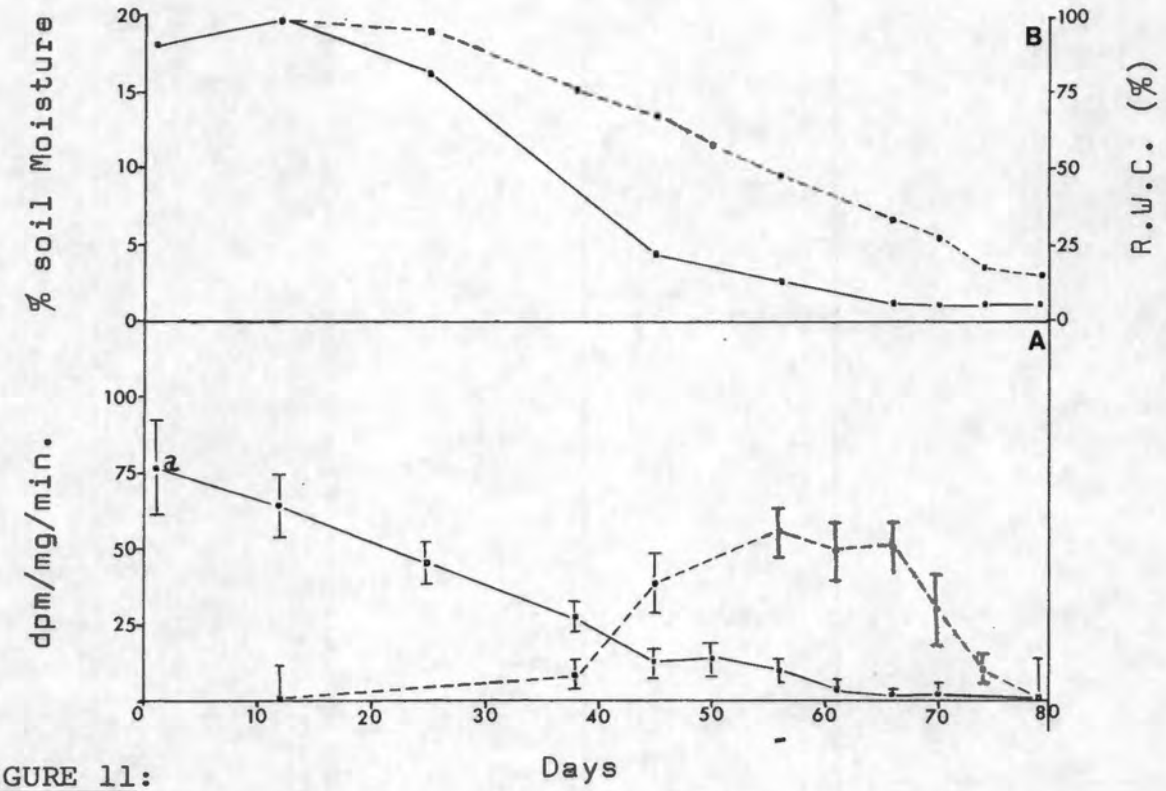

FIGURE 11:

A. Relative photosynthetic rate (•———•) and dark CO_2 uptake (•-------•) of *Euphorbia mauritanica* with increasing drought. (a, significantly different from final reading (day 79) at the 1% level).

B. Percentage soil moisture (•———•) and relative water content (R.W.C.) (•-------•) of *E. mauritanica*. (Last watered on day 12)

In *Crassula fasicularis*, although there is an increase in dark CO_2 fixation and a decrease in light photosynthesis, there is always a significant amount of dark CO_2 uptake occuring. This species is therefore, perhaps a facultative CAM species which does show some modification of the CAM pattern when subjected to severe water stress.

The photosynthetic rates of the succulents were much lower then the evergreen and deciduous species at the beginning of the experiment. As the photosynthetic rates of the evergreen species decreased they reached the same level as the photosynthetic rates of the succulents. The dark CO_2 fixation of the succulent is higher than the evergreen photosynthetic rates of the evergreen species at the peak of the CO_2 dark uptake. However, in *Carboprobutus mellei*, *Crassula fasicularis*, and *Euphorbia mauritanica* the dark CO_2 uptake dropped to the same level as the photosynthetic rates of the evergreen species. *Aloe littoralis* and *Cotyledon orbiculata* showed a slight decrease in the dark CO_2 fixation rate but it did not decrease to the same as all the other species.

3.2. Percentage Soil Moisture

In all of the species studied there is a decrease in soil moisture. The differences in the rapidness of the drying of the soil is probably due to the different sizes of pots used. All of the soil moistures decreased to between 1 - 2%.

In the succulents the rate of dark CO_2 fixation only dropped significantly when the soil moisture was between one and two percent. The photosynthetic rates in all the species dropped gradually as the soil moisture dropped. There was no noticeable difference between the different types of plants.

3.3. Relative Water Content

The relative water content also showed a decrease with an increase in time. All the plants that survived 9½ weeks of drought viz. *Cotyledon orbiculata, Aloe littoris, Erica sp., Euryops condolei, Euclea undulata,* and *Rhus lucida* showed a levelling off of R.W.C. between 20-25% whereas the other species showed no levelling off but continued decreasing. The R.W.C. decreases gradually as the soil moisture drops.

4. DISCUSSION

Acacia nigrescens, the deciduous species started losing its leaves after about 6 weeks of drought. If this species had been watered after 9,5 weeks of drought it probably would have recovered as these trees usually stand bare for several months in the year. However, the drought was possible too severe especially as its root system was necessarily poorly developed due to the smallness of the pot. This is probably why it never recovered after 17½ weeks of drought. This species is adapted to drought by shedding its leaves as soon as it is subject to water stress. When water becomes available it would then be able to resprout.

The evergreen species studied did not shed their leaves but retained them and appeared to stop photosynthesizing. The *Erica sp.* plant that was watered after 9 weeks of drought recovered within a week and started photosynthesizing. Its photosynthetic rate had not reached the level of the original rate but probably would have. This indicates the ability of these plants to remain capable of rapid resumption of activity when moisture becomes available. This is possibly advantageous in allowing the plant a start over species which have to develop both new shoots and leaves. The term 'dormancy' has been rather loosely applied to any condition in which the plant is not actively growing and metabolizing. However, 'dormancy' is much more useful a term if restricted to that inactive condition from which the plant does not emerge unless

subjected to a specific environmental stimulus or until a specific minimum of time has elapsed. The specific stimulus is always different from the conditions normally necessary for plant growth (e.g.) low or high temperature, or a certain period of darkness). Conditions like that of these non-active evergreen species are fundamentally different. Here the plants seem to stop activity whenever the environment becomes unsuitable and begin activity whenever general environmental conditions favourable to growth re-occur. For such a condition 'quiescence' seems a more suitable term. It appears therefore, that these evergreen species have the ability to 'switch off' their photosynthetic pathway in a drought. They would then remain in this quiescent state until moisture becomes available and they once again start photosynthesizing. Thus, the evergreen species such as *Euclea undulata* and *Rhus lucida*, which appear to have no morphological adaptations to withstand drought, could owe their ability to survive drought to this physiological adaptation. The other two species viz. *Erica sp.* and *Europs condolei* which do have a reduction in surface area have this added physiological adaptation.

The succulents, which were all CAM plants, had very low photosynthetic rates. The photosynthetic rates dropped with increasing drought but the rate of dark carbon dioxide increased. They did not appear to 'shut down' completely as the evergreen species did but merely switched from light CO_2 uptake to dark CO_2 uptake. However, *Aloe littoralis* and

Cotyledon orbiculata, which survived did show a slight decrease in dark CO_2 uptake. The other three species only showed a drop in dark CO_2 uptake near the end of the period, they did not however, recover from the drought. This drop could therefore, be seen as indicative of their dying.

In all the succulent species, with the exception of *Crassula fasicularis* the nocturnal CO_2 uptake only became important after a length of droughting. When these plants were watered, they showed what appeared to be a typical C_3 photosynthetic pathway with all significant CO_2 uptake being during the daylight. They were, however, induciable CAM species. When the CO_2 uptake began dropping with increased water stress a minimum level was reached and then dark CO_2 uptake increased. This shift from C_3 photosynthesis to CAM has been reported for a number of species. Not all taxonomic groups have been tested for shifts, but some species of the Aizoaceae and Portulaceae have been studied and shown to have this shift (Chaturvedi & Zabka, 1977; Ting & Hanscom, 1977; Kluge & Ting, 1978; Ting, 1978). Data seems to indicate that the first response to water stress is diurnal stomatal closing, and it is perhaps this step which acts as the stimulus for further induction (Ting, 1978). In the succulents studied there did not appear to be a complete diurnal closure of the stomata before nocturnal CO_2 uptake started. However, the decrease in photosynthesis indicates some closure of the stomata and this could have caused the induction of nocturnal CO_2 uptake.

In *Crassula fasicularis* the dark CO_2 uptake was always significant. However, even this species showed some modification with increased water stress. The CO_2 uptake during the day decreased and the nocturnal CO_2 uptake increased as the water stress increased. Thus, this species appears to be a facultative CAM species, although it does show some modification of its CO_2 uptake pattern when under stress.

The photosynthetic rates of the CAM species are considerably lower than the evergreen and deciduous species, which are C_3 plants. This is consistent with the general observation that CAM plants have relatively low growth rates (see Table 2).

TABLE 2: SOME ECOLOGICALLY RELEVANT DATA DISTINGUISHING CAM AND C_3 PLANTS (FROM BLACK,1973; KLUGE & TING,1978)

	CAM	C_3
Transpiration Ratio (g H_2O. g^{-1} dry matter)	18 - 100 (dark) 150 - 600 (light)	450 - 900
Max. rate of net photosynthesis (M CO_2. dm^{-2}. h^{-1})	1 - 4	15 - 40
Max. growth rate (g dry wt. dm^{-2}. d^{-1})	0,0015 - 0,0018	0,5 - 2

All of the plants were grown under artificial conditions as they were grown in pots which restricted the development of their rooting systems. All of the evergreen species would have extensive deep rooting systems. Cannon (1924) studied the same genera and found that these genera had well developed

main roots with extensive branching. On the other hand, the succulents have a poorly developed rooting system which is usually superficial (Cannon, 1924). *Acacia* species have also been shown to have extensive deep rooting systems (Cloudsley-Thompson, 1977). The evergreen and deciduous species therefore were more restricted in the growth of their root system than the succulents. If grown under natural conditions the deciduous and evergreen species would probably have been able to obtain water from deep soil long after the surface soil became extremely dry. The succulents probably did not have such a severe restriction on the growth of their root systems. The drought would therefore have been relatively more severe for the evergreen and deciduous species when compared to the succulents.

The age of the plants could also be important. Most of the plants used were very young and small especially *Erica sp*, *Euclea undulata*, and *Europs condolei*. *Cotyledon orbiculata* and *Carpobrotus mellei* were relatively large, old and well established plants. The very young plants could be less drought tolerant than they would be when older. Thus, it is possible that the evergreen plants would have survived longer under natural conditions when their root systems were not restricted and the plants were well established and relatively mature.

4.1. Succulent Distribution in South Africa.

Among the various individual climatic parameters which influence the gross features of the vegetation differences on earth van Riper and Walter (in Schulze & McGee, 1978) consider the most important to be water. The reservoir of soil water on which the plants draw is derived mainly from rainfall, fog, and snow, of which the first two are considered important in South Africa. Most major sub-divisions of vegetation formations on a subcontinental scale reflect the annual and seasonal soil moisture balances rather than gross precipitation income.

A water deficiency, according to Carter (in Schulze & McGee, 1978), is equivalent to drought - it is the need for moisture required by vegetation that soil storage and precipitation have failed to meet. The average annual water deficiency map (Fig.12) indicates that drought to some degree occurs all over South Africa except along the eastern fringe.

Succulents are found virtually throughout South Africa. They are, however, only a dominant part of the vegetation in a relatively small area (see Fig.1).

Of the succulents used in this study *Crassula fasicularis*, Carpobrotus mellei, and *Euphorbia mauritanica* are temperate species. *Aloe littoralis* is a sub-tropical species, and is found mainly in northern S.W.A. and Angola. *Cotyledon orbiculata* although very widespread in South Africa is also a sub-tropical species. Thus the two species that survived the drought are sub-tropical

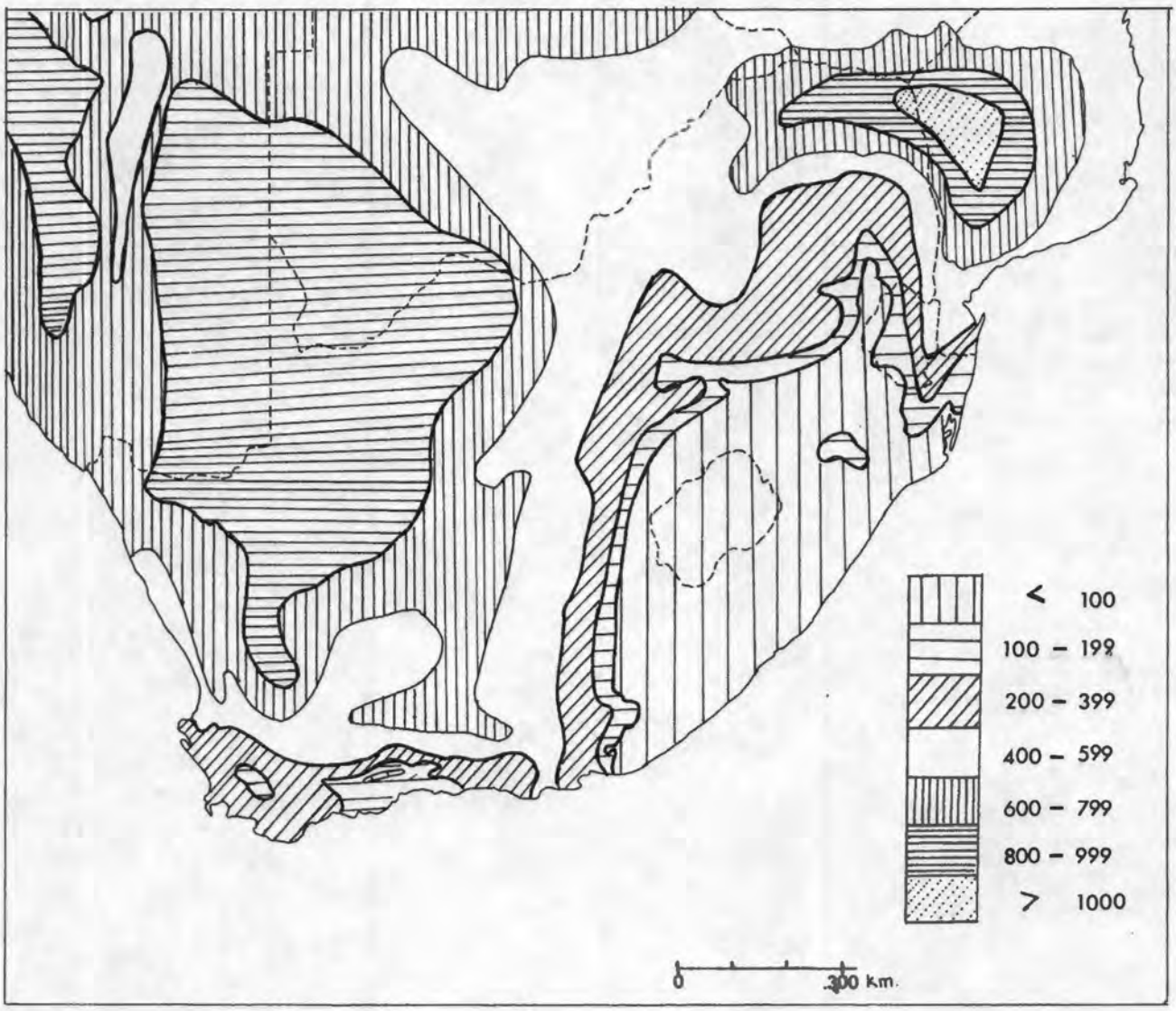

FIGURE 12:

Annual Water Deficiency (Schulze & McGee, 1978).

species while the three that died are temperate species. The temperate species are winter growing usually in a temperature range of 10-20° C. The sub-tropical species are however, summer growers in a temperate range of 15-25° C. The conditions that the plants were subject to were therefore more suited to sub-tropical species as they were grown in a temperature range of 20-30° C.

In looking at the distribution map the obvious feature is the lack of succulents in the Great Karoo and Kalahari area. Although some mesems do occur in this area it is generally a region very poor in succulents. This at first would appear to be rather unusual especially as succulents are usually thought to be associated with dry regions. The Great Karoo receives on an average, less rain then the area dominated by succulents. The annual water deficiency is also greater in parts of the Great Karoo.

When looking at the results obtained in the photosynthetic study and the ability of the plants to survive drought, it becomes apparent that the winter growing succulent species are not able to survive a long drought. Thus the fact that this area has a larger annual water deficit than the area with succulents as dominant could explain the absence of succulents. The succulents would not be able to survive as the water deficit would be too great.

The winter growing succulents appear to be found mainly in the winter and all year rainfall regions as mapped by Gillooly

and Dyer (1979) (see Fig.13). From Fig.14 it can be seen that most of the area dominated by winter rainfall growing succulents receives 60% or less of their rainfall in summer. Thus the winter growing succulents probably need to receive some winter rainfall. This is probably because they are winter growing and thus require some moisture to enable them to grow. However, most of these regions do receive some precipitation in summer. A small amount of precipitation would be available to succulents because they have very superficial rooting systems.

Low temperature is a criterion that could be thought of as another possible explanation for the absence of succulents in the Great Karoo. However, if one considers that at Sutherland there are a large number of succulents present in the vegetation (van Jaarsveld, pers comm.), and that Sutherland has very low winter temperatures, then this explanation no longer seems to be valid.

If one looks at precipitation figures for Sutherland it receives on an average, some precipitation every month of the year.(Thornthwaite & Mather, 1962). Average rainfall figures for weather stations in the Great Karoo also show that they receive some precipitation in every month of the year (Thornthwaite & Mather, 1962). However, if one looks at the storage of moisture in the soil which according to Lundholm, (1976) is the critical factor for the vegetation and not the actual precipitation, the difference between these areas seems much clearer. Sutherland always has soil moisture

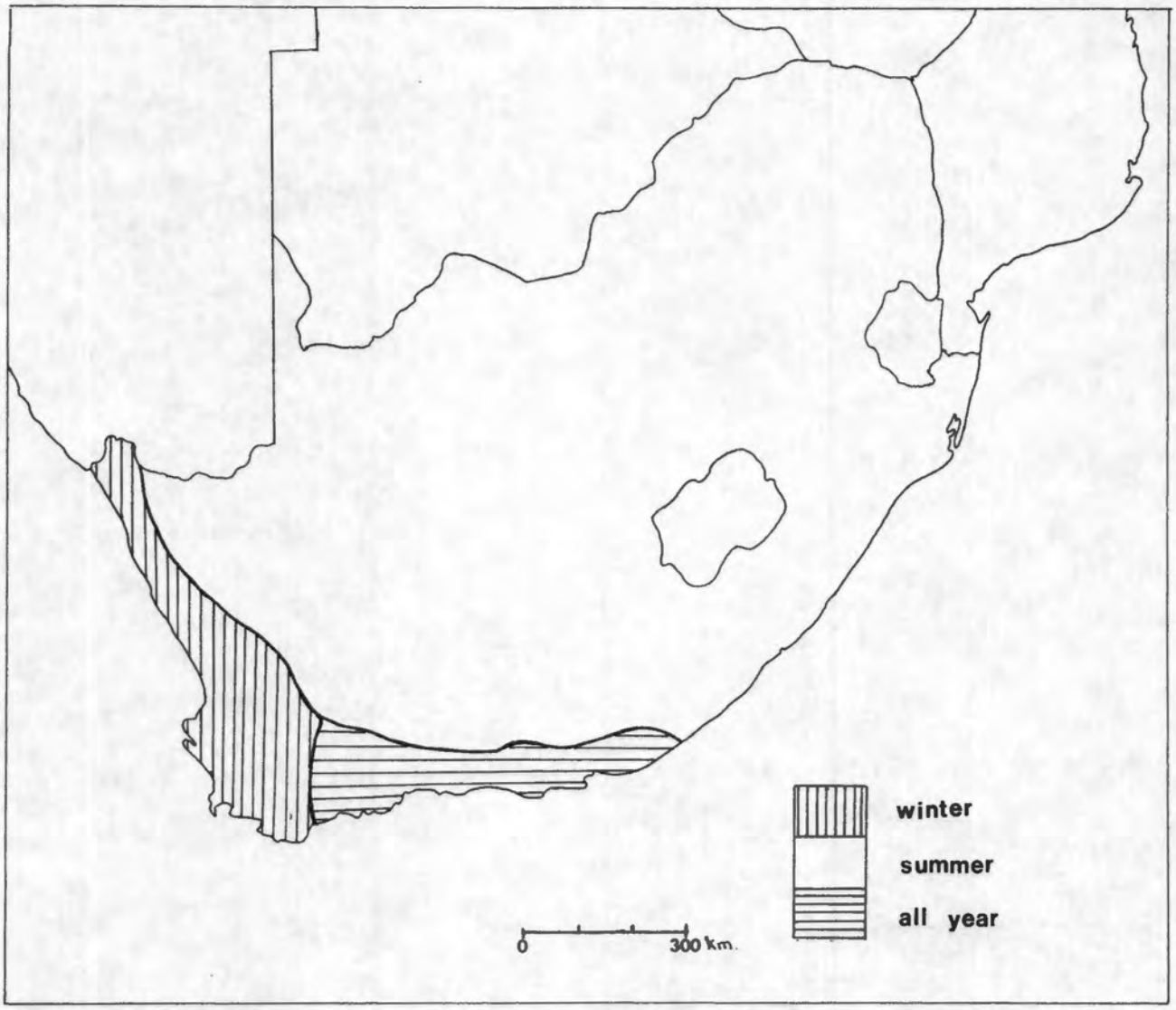

FIGURE 13:

Winter, summer and all year rainfall regions of South Africa (Gillooly & Dyer, 1979).

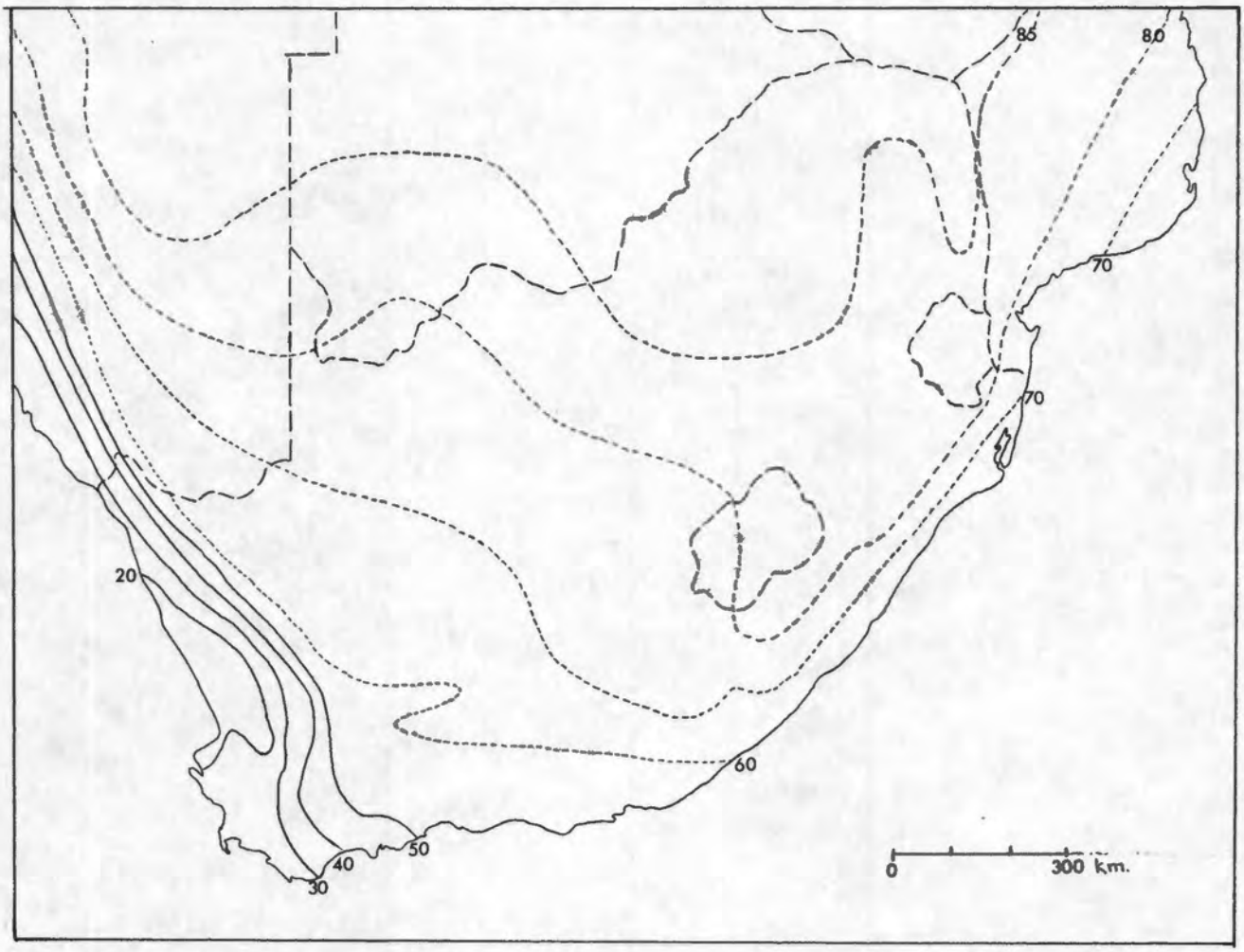

FIGURE 14:

Summer rainfall (October - March) as a percentage of annual mean.

(South African Weather Bureau,1957).

throughout the year, whereas Carnarvon where very few succulents occur, never has any moisture stored in the soil (Thornthwaite & Mather, 1962).

It must also be remembered that a large part of the Karoo is subject to two different systems, viz. the summer and winter rainfall systems. In the former type, thunderstorm activity and instability showers are predominant, whereas winter rainfall is brought by cyclonic disturbances, which skirt the south-western Cape coast. Thus, the Karoo is probably subject to far more erratic rainfall behaviour as it receives between 40-70% of its rainfall in summer and the rest in winter. It is possible that the area dominated by succulents because it receives most of its rain in winter does not have as erratic rainfall as does the area where succulents are virtually absent. Further research is needed however, before this type of interrelationship, between rainfall anomalies and succulent distribution patterns can be elucidated.

It would appear therefore, that with regard to succulents, the most important factor limiting their distribution is water - especially soil moisture. They would seem unable to survive a prolonged drought when compared to drought tolerant evergreen species. Especially as the evergreen species which were studied survived longer than the three temperate succulent species even though they had severely restricted rooting systems as well as being very young plants. The difference in survival ability possibly being in the fact that the evergreen species prevent water loss

by stomatal closure which is indicated by the decline in photosynthesis. The succulents, although they show diurnal stomatal closing, water would still be lost at night as they still show nocturnal stomatal opening. It is also likely that the evergreen species would survive a much longer period of quiescence than the succulents could if the succulents 'shut down' completely. This would be due to the fact that the evergreen species would have a much larger build up of photosyntate than the succulents due to their much higher photosynthetic rate. The succulents may thus be unable to 'close down' for any length of time. The evergreen species may therefore be able to withstand a longer drought than the succulents.

In other parts of the world where succulents appear to occur in very dry regions, a careful study of annual moisture and soil moisture storage could perhaps show that these areas are not as dry as they apparently seem or possibly the soils are capable of storing water efficiently for a significant length of time. What is needed therefore, is a detailed study of climatic records of dry areas where succulents are absent and areas where they form a dominant part of the vegetation. As such this study can not be regarded as conclusive but rather as speculative with the regard to the distribution of succulents.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. E.J. Moll for help and advice, Mr. E. van Jaarsveld of Kirstenbosch for providing the plants, the map on succulent distribution and helpful discussion and Mr. H. Botha for technical assistance.

REFERENCES

Acocks, J.P.H., 1953. Veld Types of South Africa. Mem. Bot. Surv. S. Afr., 28: 1-92.

Black, C.C. 1973. Photosynthetic carbon fixation in relation to net CO_2 uptake. Ann. Rev. Plant Physiol., 24: 253-286.

Cannon, W.A. 1924. General and Physiological Features of the Vegetation of the more arid Portions of Southern Africa, with Notes on the Climatic Environment. Carnegie Inst. of Washington, Washington.

Catsky, J. 1974. Water Saturation Deficit (Relative water content) in Methods of Studying Plant Water Relations (Ed. B. Slavik) p.136-156. Chapman & Hall Ltd., London.

Chaturvedt, S.N. Zabka, G., 1977. Studies on dark fixation of carbon dioxide in Kalanchoë I. Effect of water stress and growth retardants. Ann. Bot., 41(173): 493-500.

Cloudsley-Thompson, J.L. 1977. Man and the Biology of Arid Zones. Edward Arnold, London.

Gillooly, J.F., Dyer, T.G.J., 1979. Spatial variations in rainfall during abnormally wet and dry years. S.Afri. J. Sci., 75(6) : 261-262.

Kluge, M., Ting, I.P. 1978. Crassulean Acid Metabolism Analysis of an Ecological Adaptation. Springer-Verlag, New York.

Levitt, J., 1972. Physiological Ecology : Response of Plants to Environmental Stresses., Academic Press, London.

Lundholm, B., 1976. Adaptations in arid ecosystems. In Can Desert Encroachment be Stopped? A study with emphasis on Africa. (Eds. A. Rapp, H.N. Le Houerou, and B. Lundholm), p.19-27. Ecological Bulletins No.24. Swedish National Science Council, Stockholm.

Parker, J., 1968, Drought resistance mechanisms. In Water Deficits and Plant Growth, Vol.1 (Ed. T.T. Kozlowski) Academic Press, London.

Schulze, R.E., McGee, D.S., 1978. Climatic indices and classifications in relation to the biogeography of Southern Africa. In Biogeography and Ecology of Southern Africa. (Ed.M.J.A.Werger) p.19-52, Junk, The Hague.

Shields, L.M., 1950. Leaf xeromorphy as related to physiological and structural influences. Bot. Rev., 16 : 399-447

South African Weather Bureau, 1957. Climate of South Africa, Part 4 : Rainfall maps, Dept. of Transport, Pretoria.

Spomer, L.A., 1972. Evaluation of edge injection errors in the floating leaf disk method of measuring leaf tissue water deficit. Plant Physiol., 49 : 1027-1028.

Thornthwaite, C.W., Mather, J.R., 1962. Average Climatic waters balance data of the continents. Part 1: Africa. Publications in Climatology, 15(2) : 115-287.

Ting, I.P., 1978. Some recent developments in Crassulacean Acid Metabolism. Whats New in Plant Physiol., 9(12) : 45-48.

Ting, I.P., Hanscom, Z., 1977. Induction of acid metabolism in Portulacaria afra. Plant Physiol., 59 : 511-514.

Vosnesenskii, V.L. Zalenskii, O.V., Austin, R.B., 1971. Methods of measuring rates of photosynthesis using $^{14}CO_2$. In Plant photosynthetic Production - manual of methods. (Eds. Z.Sestak, C.Catsky, P.G.Jarvis). p.276-293, W. Junk, The Hague.

APPENDIX 1.

Relative photosynthetic rates and dark carbon dioxide fixation of ;

i) *Acacia nigrescens*

ii) *Erica sp.*

iii) *Euclea undulata*

iv) *Euryops condolei*

v) *Rhus lucida*

vi) *Aloe littoralis*

vii) *Cotyledon orbiculata*

viii) *Carpobrotus mellei*

ix) *Crassula fasicularis*

x) *Euphorbia mauritanica*

SPECIES: Acacia nigrescens. (i)

DRY WEIGHT = 4.6 mg.

BLANK = 58,2.

DATE 23/4 DAY No. 12 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,285	85,2	25789,7	25731,5	5593,8	124,3	145,9
0,298	86,0	28231,1	28172,9	6124,5	136,1	158,3
0,279	85,0	22460,4.	22402,2.	4870,0	108,2	127,3
					AVERAGE =	143,8 ± 15,6

DATE 6/5 DAY NO. 25 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,284	85,1	3262,3	3204,1	696,5	23,2	27,3
0,277	84,8	2509,5	2451,3	582,9	17,8	20,9
0,272.	84,3	2214,5	2156,3.	468,8	15,6	18,5
					AVERAGE =	22,3 ± 4,5

DATE 19/5 DAY No. 38 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,298	86	1753,4	1695,2	368,5	12,3	14,3
0,232	81,8	1878,1	1819,9	395,6	13,2	16,1
0,255	83,3	1693,5	1635,3	355,5	11,9	14,2
0,183	79,2.	1339,1	1280,9	278,5	9,3	11,7
					AVERAGE =	14,1 ± 1,8.

SPECIES: Acacia nigrescens

DRY WEIGHT = 4,6 mg.

BLANK = 58,2.

DATE 26/5 DAY No. 45 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / min	DPM
0,215	80,8	1926,8	1868,6	406,2	9,0	11,2
0,233	81,9	1094,0	1035,8	225,2	5,0	5,9
0,278	84,9	1527,4	1469,2.	319,4	7,1	8,4
					AVERAGE =	8,5 ± 2,6.

DATE 6/6 DAY NO. 56 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,176	78	242,6	184,4	40,1	1,3	1,7
0,212	80,4	304,6	264,4	53,6	1,8	2,2
0,231.	81,7	580,4	522,2.	113,5	3,8	4,6
						2
					AVERAGE =	2,9 ± 1,6.

DATE ----- DAY NO. ----- [ ]

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Erica sp. (ii)

DRY WEIGHT = 0,38 mg.

BLANK = 106,5.

DATE 12/4/79. DAY No. 1 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,164	77,3	4319,7	4213,2	11087,4	369,6	478,1
0,153	76,2.	3963,7	3857,2	10150,5	338,4	440,0.
0,112.	72,7.	4475,7.	4369,2.	11497,9.	383,3.	527,2.
					AVERAGE =	481,8 ± 178,3

DATE 30/4 DAY NO. 19 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,155	76,5	5292,9	5186,4	13648,4	454,9	594,7
0,172	78,7	3813,8	3707,3.	9756,1	325,2	413,2.
0,191	82,5	3076,1	2969,6	7814,7	260,5	315,7
0,141.	75,3.	3781,5	3675,0.	9671,1	322,4	428,1
					AVERAGE =	437,9 ± 115,8.

DATE 11/5 DAY No. 30 LIGHT 45 min

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,298	86	4338,5	4232,0	11136,8	247,5	287,8
0,259	83,3	5198,8	5092,3	13400,8	297,8	357,5
0,281	85	1075,4	968,9	2549,7	56,7	66,7
0,297	85,9	3412,6	3306,1	8700,3	193,3	225,1
0,346.	88,3.	6674,7	6568,2.	17284,7	384,1.	435,6.
					AVERAGE =	274,4.

SPECIES: Erica sp.

DRY WEIGHT = 0, 38 mg.

BLANK = 106 ,5.

DATE 26/5 DAY No. 45 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,158	76,6	2499. 2	2392,7	6296,6	209,9	274.0
0,247	83	1726, 3	1619, 8	4262, 6	142,1	171, 2
0,266	84	1512 . 4	1405,9	~~39~~3699 ,7	123,3	146,8
0,232.	82,8	1247, 5	1141, 0.	3002, 6.	100, 1.	120,9
					AVERAGE =	178, 2 ± 67,1.

DATE ~~31/5~~ 6/6. DAY NO. ~~56~~ 56 LIGHT [illegible]

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,242	82,5	526, 5	420 ,0	1105,3	24,6	29, 8
0, 294	85,9	404 ,8	298 ,3	785,0	17,4	20 ,3
0,228	81,8	514, 2	407,7	1072 ,9	23,8	29,1
0,260.	83,8	276,1.	169, 6.	446,3	9,9.	11,8
					AVERAGE =	22, 8 ± 8, 5.

DATE 31/5 DAY No. 50 LIGHT 45 minutes.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,299	86	724,5	618	1626 , 3.	36,1	42,0
0,202	80	594,0	487,5	1282, 9	28,5	35, 6
0, 292	85,8	717,6	611, 1	1608 , 2	35,7	41, 7
0, 264	84.	694,4	587,9	1547,1.	34,4.	40,9
					AVERAGE =	40 ,1 ± 2,98.

SPECIES: Erica sp.

DRY WEIGHT = 0,38 mg.

BLANK = 106,5.

DATE 11/6. DAY No. 61. LIGHT

45 min.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,177	78,0	140,2	33,7	88,7	2,0	2,5
0,241	82,5	159,0	52,5	138,2	3,1	3,7
0,226	81,5	~~159,4~~ 195,4	88,9	233,9	5,2	6,4
0,147.	76,0.	124,8.	18,3.	48,2.	1,1.	1,4
					AVERAGE =	3,5 ± 2,1

DATE 16/6. DAY NO. 65 LIGHT

~~45 min~~.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,289	85,4	88,7	– 17,8	0	0	0
0,235	84,9	68,8	– 37,7	0	0	0
0,272	84,3	152,5	46	121,1	2,7	3,2.
0,271	84,3.	91,2	– 15,3	0	0	0
					AVERAGE =	0,8 ± 1,6.

DATE 20/6. DAY No. 70. LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM.
0,055	64,5	41,7	– 64,8	0	0	0
0,149	64,2	80,5	– 26	0	0	0
0,077	68	65,4	– 41,1	0	0	0
0,203	80	53,8	53,8	141,6	3,1	3,9
					AVERAGE =	1,0 ± 1,9.

SPECIES: Erica sp.

DRY WEIGHT = 0,38 mg.

BLANK = 106,5.

DATE 28/6 DAY No. 79. LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,198	79,8	89,6	- 16,9	0	0	0
0,162	77	54,2	- 52,3	0	0	0
0,142.	75,1	109,7	3,2	8,4	0,3	0,4
					AVERAGE =	0,1 ± 0,2.

WATERED PLANT.

DATE 28/6 DAY NO. 79 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,151	76	1282,2	1175,7	3093,9	103,1	135,7
0,130	74,4	1669,0	1562,5	4111,8	137,1	184,2
0,123.	74	1912,6.	1806,1	4752,9	158,4	214,1
					AVERAGE =	178,0 ± 39,6

DATE ----- DAY NO. ----- [ ]

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Eucles undulata. (iii)

DRY WEIGHT = 1,9

BLANK = 92.

DATE 23/4 DAY No. 12 LIGHT

30 min.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,195	79,5	10,284,5	10192,5	5364,48	178,82	224,9
0,337	87,9	11235,4	11143,4	5864,95	195,50	222,4
0,405	91,5	11866,6	11774,6.	6197,16.	206,57	225,8
						#
					AVERAGE =	224,4 ± 1,74.

DATE 6/5 DAY NO. 25 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,255	83,4	1200,3	1108,3	583,5	19,4	23,3
0,236	82,2.	1714,2	1622,2	846,4	28,2	34,3
0,315	86,7	1555 8	1463,8	770,4	25,7	29,6
0,279.	84,8.	2418,4	2326,4	1224,4	40,8	48,1
					AVERAGE =	33,8 ± 10,54.

DATE 19/5 DAY No. 38 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,206	80,3	1490,8	1398,8	736,2	24,5	30,6
0,228	81,8	1229,0	1137,0	598,4	19,9	24,4
0,174	78	1928,4	1836,4	966,5	32,2	41,3
0,199.	79,9.	968,9.	876,9.	461,5	15,4.	19,3
					AVERAGE. =	28,9 ± 9,49.

SPECIES: Euclea undulata

DRY WEIGHT = 1,9 mg.

BLANK = 92,0

DATE 26/5 DAY No. ~~25~~ 45 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,218	81,2	800,8	708,8	373,1	12,4	15,3
0,114	73,1	886,5	794,5	418,2	13,9	19,1
0,289	85,3	835,7	743,7	391,4	13,0	15,3
0,315	86,7.	1082,7	990,7.	521,4	17,4.	20,0
					AVERAGE =	17,4 ± 2,49.

DATE 31/5 DAY NO. 50 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,231	81,9	120,2	28,2	14,8	0,5	0,8
0,247	83,0	300,4	208,4	109,7	3,7	4,4
0,241	82,5	311,3	219,3	115,4	3,8	4,7
0,060	66,1	648,0	556,0	292,6	9,8	14,8
					AVERAGE =	6,2 ± 6,0.

DATE 6/6 DAY No. 56 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,217	81.1	93,5	1.5	0,8	0,03	0,03
0,242	82,6	301,5	209,5	110,3	3,7	4,4
0,216.	81,0.	848,0.	756,0	397,9	13,3.	16,4
					AVERAGE =	6,7.0 ± 8,5.

SPECIES: Eudea sp.

DRY WEIGHT = 1,9

BLANK = 92,0.

DATE 11/6 DAY No. 61 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm /mg	cpm /mg /m	DPM
0,060	66,1	350,2	258,2	135,8947	4,5298	6,8530
0,155	76,5	193,5	101,5	53,4211	1,7807	2,3277
0,070	67,8	545,5	453,5	238,6842	7,9561	11,7347
				S.D. = 4,70.	AVERAGE =	6,9718

DATE 16/6 DAY NO. 66 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm /mg	cpm/mg/m	DPM.
0,132	74,3.	171,9	79,9	42,0526	1,4018	1,8867
0,164	77,2.	77,3	–	–	–	–
0,141	75,2.	396,4.	304,4.	160,2105	5,3404	7,1016
				S.D. = 3,68	AVERAGE =	2,996,1.

DATE 29/6 DAY NO. 79 LIGHT

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm/mg/min	DPM.
0,223	81,5	185,6	93,6	49,3	1,6	2,0.
0,216	80,9	148,2	56,2	29,6	1,0	1,2.
0,189	79,0	196,7.	104,7	55,1	1,8.	2,3.
					AVERAGE =	1,8 ± 0,9

SPECIES: Euryops condolei

DRY WEIGHT = 0,5 mg.

BLANK = 45,6

DATE 23/5 + DAY No. 12 — LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,192	79,1	4222,6	4177,0	8354,0	278,4667	352,0439
0,260	83,8	4333,8	4288,2	8576,4	285,8800	341,1456
0,244	82,8	4087,7	4042,1	8084,2	269,4733	325,4508

S.D. = 13,37. AVERAGE = 339,5467

DATE 6/5 DAY NO. 25 LIGHT 20 min

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,337	88,0	5180,5	5134,9	10269,8	342,3	389,0076
0,177	78,0	3426,1	3380,5	6761,0	225,4	288,9316
0,173	77,8	3305,6	3260	6520	217,3333	279,3487
0,276	84,8	2824,7	2779	5558,2	185,2733	218,4826

S.D. = 70,64. AVERAGE = 293,9426

DATE 19/6 DAY NO. 38 LIGHT

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,241	82,5	1675,5	1629,9	3259,8	108,6600	131,7091
0,260	83,7	1625,4	1579,8	3159,6	105,32	125,8805
0,241	82,5	1594,0	1548,4	3096,8	103,2267	125,1233
0,249	83,0	1430,4	1384,8	2769,6	92,32	111,2289

S.D. = 8,68 AVERAGE = 123,4729

SPECIES: Euryops condolei

DRY WEIGHT = 0,5 mg

BLANK = 45,6

DATE 26/5 DAY No. 45 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,115	73,3	432,8	387,2	774,4	25,8133	35,2160
0,127	74,2	494,7	449,1	898,2	29,9400	40,3504
0,156	76,5	488,6	443	886	29,5333	38,6056
0,137	74,7	478,2	432,6	865,2	28,84	38,6078
			S.D. = 2,15		AVERAGE =	38,1949

DATE 6/6 DAY NO. 56 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,265	84,0	281,4	235,8	471,6	15,7200	18,7143
0,246	82,8	275,5	229,9	459,8	15,3267	18,6911
0,271	84,4	280,5	234,9	469,8	15,6600	18,5545
0,123	73,9	201,4	155,8	311,6	10,3867	14,0551
			S.D. = 2,30		AVERAGE =	17,5037

DATE 11/6 DAY NO. 61 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,370	89,5	188,9	143,3	286,6	9,5533	10,6741
0,325	87,1	126,5	80,9	161,8	5,3933	6,1921
0,143	75,6	104,3	58,7	117,4	3,9133	4,2239
0,221	81,4	111,4	65,8	131,6	4,3867	5,3891
			S.D. = 2,82		AVERAGE =	6,6198

DRY WEIGHT = 0,5 mg.

BLANK = 45,6

DATE 20/6. DAY No. 70 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,292	85,6	92.6	47	94	3, 1333	3, 6604
0,171	77,7	87,0	41,4	82.8	2, 76	3, 5521
0,189	79.1	96,0	50,4	100,8	3,36	3, 5000
0,228	81 7	81,9	36,3	72.6	2.42	2, 9621
				s.d. = 0,31.	AVERAGE =	3, 4186

DATE 29/6 DAY NO. 79 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,262	83.8	60,4	14,8	29,6	0,9867	1, 1774
0,242	82,6	37,4	0	0	0	0
0,273	84,6	45,9	0,3	0,6	0,0200	0,0236
0,301	86,0	58,9	13,3	26,6	0,89	1 , 0510
				s.d. = 0,63.	AVERAGE =	0,6 ± 0,6.

DATE ----- DAY NO. -----

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Rhus lucida (V)

DRY WEIGHT = 1,6 mg.

BLANK = 63,1

DATE 23/4 DAY No. 12 LIGHT

45 min.

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,388	90,5	35990,5.	35927,4	22454,625	498,9917	551,372.
0,288.	85,3	23 016,9	22 953,8	14346,125	318,8028	373,7630
0,306	86,9	20 370,4.	20307.3.	12692,062	282,0458	326,8201

S.D. = 118,5. AVERAGE = 417,3117.

DATE 6/5 DAY NO. 25 LIGHT 30 min

Ext. std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,230	81.8	10,863,7	10 620,6	6637,875	221,2625	270,4920
0,183	78.7	10158,0	10 094,9	6309,3125	210,3104	267,2305
0,183	78,7	7857,9	7794.8	4871,7500	162,3917	206,3427

S.D. = 36,13. AVERAGE = 248,0217.

DATE 19/5 DAY No. 38 LIGHT 30 min

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,337	88.	5180,5	5117,4	3198,3750	106,6125	121,1506
0,177	78	3426.1	3363,0	2101,8750	70,0625	89,8257
0,173	77,8	3305,6	3242,5	2026,5625	67,5521	86,8279
0,275	84,5.	2824,7	2761.6	1726,0000	57,5333	68,0867

S.D. = 22,00 AVERAGE = 91,4722.

SPECIES: Rhus lucida

DRY WEIGHT = 1,6mg.

BLANK = 63,1.

DATE 26/5 DAY No. 45 LIGHT

30 min

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,173	78,0	1674,5	1611,4	1007,125	33,5708	43,0395
0,224	81,4	1625,4	1562,3	976,4375	32,5479	39,9851
0,198	79,9	1594,0	1530,9	956,8125	31,8938	39,2298
0,223	81,3	1430,4	1367,3	854,5625	28,4854	35,0374
				S.D. = 3,27	AVERAGE =	39,3229

DATE 31/5 DAY NO. 50 LIGHT 30 min

Ext. std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,232	82	1274,0	1210,9	756,8125	25,2271	30,7648
0,267	74,1	1815,6	1752,5	1095,3125	36,5104	49,2718
0,229	81,8	423,6	360,5	225,3125	7,5104	9,1814
				S.D. = 20,06	AVERAGE =	29,7393

DATE 11/6 DAY NO. 61 LIGHT 30 min

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,099	71,7	743,0	679,9	424,9375	14,1646	19,7554
0,099	71,7	581,3	518,2	323,8750	10,7958	15,0569
0,136	75	490,4	427,3	267,0625	8,9021	11,8695
0,138	75,2	472,9	409,8	256,1250	8,5375	11,3531
				S.D. = 3,87	AVERAGE =	14,5087

SPECIES: Rhus lucida

DRY WEIGHT = 1.6 mg.

BLANK = 63,1

DATE 20/6 DAY No. 70 LIGHT

30min

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,138	75,2	385,1	322	201,25	6,7083	8,9206
0,160	76,9	261,0	197,9	123,6875	4,1229	5,3614
0,195	79,7	368,7	305,6	191,0000	6,3667	7,9883
0,119	73,5	360,8	297,7	186,0625	6,2021	8,4382
				S.D. = 1,59	AVERAGE =	7,6771

DATE 29/6 DAY NO. 79 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,292	85,6	230,9	167,8	104,88	3.50	4,09.
0,171	77,7	248,6	185,5	115,94	3,86.	4,97
0,189	79,1	261,0	197,9	123,69	4,12	5,21.
0,228	81,7	242,5.	179,4	112,13	3,74	4,58.
					AVERAGE =	4,71 ± 0,67

DATE ----- DAY NO. ----- [ ]

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27

BLANK = 79.0.

DATE 23/4. 12/4 DAY No. 1 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,311	85,2	5542,0	5463,0	751,4	25,0.	29,7.
0,301	86,0	10468,7	10 389,7	1429,1	47,6.	55,3
0,113	73,2	7434,7	7355,7	1011,8	33,8	46,2.
					AVERAGE =	43,7 ± 12,2.

DATE 23/4 DAY NO. 12 LIGHT 45 min.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,289	85,4	10 456,1	10 377,1	1427,4	31,7	37,1
0,261	83,8	9 720,0	9641,0	1326,1	29,5	35,2
0,323	86,9	12 385,7	12306,7	1692,8	37,6	43,3
0,301	86,0	10 468,7	10 389,7	1429,1	31,8	36,9
					AVERAGE =	38,1 ± 3,6.

DATE 6/5 DAY NO. 25 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,274	84,7	6384,5	6305,5	867,3	28,9	34,1
0,311	85,2	5946,9	5867,9	807,1	26,9	31,6
0,269	84,2	5542,0	5463,0	751,4	25,0	29,7
0,204	80,2	5031,1	4952,1	681,2.	22,7	28,3
					AVERAGE =	30,9 ± 2,5.

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27 mg.

BLANK = 79.0.

DATE 19/5 DAY No. 38 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,327	87,2	3436, 2	3357,2	461, 8	15,4	17,7
0,332	87,6	3534, 2	3455,2	475,3	15,8	18,1
0,294	85,7	2429,8	2350, 8	323, 4	10,8	12,6
0,253	83,2.	1521,0.	1442,0.	198,3	6,6	7,9
					AVERAGE =	14,1 ± 4,8.

DATE 26/5 DAY NO. 45 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0, 293	85,6	1616,0	1537,0	211, 4	7,0	8,2
0,264	84,0	1381,0	1302,0	179,1	6,0	7,1
0,288	85,3	2117,0	2038,0	280,3	9,3	11,0
0,294	85,7.	1569,6.	1490,6.	205,0.	6,8	8,0
					AVERAGE =	8,6 ± 1,7.

DATE 11/6 DAY NO. 61 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0, 198	79,9	159,6	80,6	11,1	0, 4	0,5
0,263	82,7	240 ,4	161, 4	22,2	0,7	0,9
0,215	81,0.	287,7	208,7	28,7	1,0	1,2
					AVERAGE =	0,8 ± 0,4.

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27

BLANK = 79.0.

DATE ~~26/5~~ 29/6 DAY No. 79 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,167	77,3	258,8	179,8	24,7	0,8	1,1
0,170	77,6	152,1	73,1	10,1	0,3	0,4
0,124	74,0	41,0	0	0	0	0
					AVERAGE =	0,5 ± 0,5.

DATE ------ DAY NO. ----- [ ]

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

DATE ------ DAY No. ------ [ ]

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27

BLANK = 79,0

DATE 23/4 DAY No. 12 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,215	81,0	287,7	208,7	28,7	1,0	1,2.
0,198	79,9	159,6	80,6	11,1	0,4	0,5
0,332	87,6	56,2	0	0	0	0
					AVERAGE =	0,6 ± 0,7.

DATE 6/5 DAY NO. 25 DARK.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,389	90,8	2943,8	2864,8	394,1	13,1	14,5
0,305	86,2	3101,6	3022,6	415,8	13,9	16,1
0,232	81,9	2057,9	1978,9	272,2	9,1	11,1
0,147	76.	1409,1.	1330,1	183,0	6,1	8,0
					AVERAGE =	12,4 ± 3,6.

DATE 19/5 DAY NO. 38 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,252	83,1	3149,0	3070,0	422,3	14,1	16,9
0,274	84,7	3528,0	3449,0	474,4	15,8	18,7
0,279	85	2971,8	2892,8	397,9	13,3	15,6.
					AVERAGE =	

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27 mg.

BLANK = 79.0.

DATE 26/5 DAY No. 45 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,124	74	2812,9	2733,9	376,1	12,5	16,9
0,113	73,2	7434,7	7355,7	1011,8	33,7	46,1
0,116	73,4	1750,8	1671,8	229,9	7,7	10,4
					AVERAGE =	24,5 ± 19,0.

DATE 11/6 DAY NO. 61 DARK.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,314	86,8	4142,6	4063,6	559,0	18,6	21,5
0,289	85,3	4005,1	3926,1	540,0	18,0	21,1
0,211	80,5	3826,9	3747,9	515,5	17,2	21,3
					AVERAGE =	21,3 ± 0,2.

DATE 20/6 DAY NO. 70 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,	76,2	3066,8	2987,8	410,9	13,7	18,0
0,	76,2	1960,2	1881,2	258,8	8,6	11,3
0,	81,1	1847,5	1768,5	243,3	8,1	10,0
0,247	82,9	2132,7	2053,7	282,5	9,4	11,4
					AVERAGE =	12,7 ± 3,6.

SPECIES: Aloe littoralis

DRY WEIGHT = 7,27 mg

BLANK = 79.0

DATE 29/6 DAY No. 79 DARK

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,232	81,9	1468,2	1389,2	191,1	6,4	7,8
0,221	81,1	1079,3	1000,3	137,6	4,6	5,7
0,253	83,2	1246,8	1167,8	160,6	5,4	6,4
					AVERAGE =	6,6 ± 1,1

DATE ------ DAY NO. -----

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

DATE ------ DAY NO. ------

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Cotyledon orbiculata

DRY WEIGHT = 5, 3mg.

BLANK = 349.7.

DATE 12/4 DAY No. 1 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,264	84	5280,1	4930,4	930,3	31,0	36,9.
0,248	83	4687,8	43381,1	818,5	27,3	32,9.
0,137	75	3164,0	2814,3	531,0	17,7	25,6
0,174	78	4526,4	4176,7	788,1	26,3	33,7
					AVERAGE =	33,1 ± 20,0.

DATE 23/4 DAY NO. 12. LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,311	86.5	8396,5	8046,8	1518,3	50,6	58,5
0,174	78,1	2064,3	1716,6	323,5	10,8	13,8
0,222.	81,3.	5355,4	5005,7	944,5	31,5	38,7
					AVERAGE =	37,0 ± 22,4.

DATE 30/4 DAY No. 19 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0, 330	87,5	6518,7	6169, 0.	1164, 0	38,8	44,3
0,248	83	4681,8	4331, 1	818,5	27,3	32,8.
0,264	~~88~~ 81	4526,4	4176,7	788,1	26,3	32,1
ex						
					AVERAGE =	36,4 ± 7,8.

SPECIES: Cotyledon orbiculata

DRY WEIGHT = 5,3 mg.

BLANK = 349,7

DATE 6/5 DAY No. ~~45~~ 25. LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,195	80,0	4007,3	3657,6	690,1	23,0.	28,8
0,276	84,5	4413,5	4063,8	766,8	25,6	30,2.
0,232	81,9	4526,4	4176,7	788,1	26,3	32,1.
					AVERAGE =	30,4 ± 1,8.

DATE 19/5 DAY NO. 38. LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,209	80,5	1629,9	1280,2	241,5	8,1	10,0
0,232	81,9	2057,6	1707,9	322,2	10,7	13,1
0,208	80,4	2885,7	2536,0	478,5	15,9	19,8
0,216	81.	2954,2.	2604,5	491,4	16,4	20,2
					AVERAGE =	15,8 ± 5,1.

DATE 26/5 DAY NO. 45 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,223	81,3	2027,9	1678,2	316,6	10,6	13,0
0,225	81,4	1430,3	1080,6	203,9	6,8	8,3
0,188	79,1.	1445,5	1095,8	206,8	6,9	8,7
					AVERAGE =	10,0 ± 2,6.

SPECIES: Cotyledon orbiculata

DRY WEIGHT = 5,3 mg

BLANK = 249.7.

DATE 31/5 DAY No. 50 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,113	72,5	1926,6	1576,9	297,5	9,9	13,7
0,104	72,0	1702,3	1352,6	255,2.	8,5	11,8
0,107	72,2.	1871,7	1522,0.	287,2.	9,6	13,3
					AVERAGE =	12,9 ± 1,0.

DATE 3/6 DAY NO. 53 LIGHT

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,122	73,5	1319,4	969,7	183,0	6,1	8,3
0,195	80,0	1521,9	1172,2	221,2	7,4	9,2
0,155	76,5	1646,7	1297,0	244,7	8,2	10,7
0,193	80,0	1169,0	819,3	154,6.	5,2.	6,4
					AVERAGE =	8,7 ± 1,8.

DATE 20/6 DAY No. 70 LIGHT

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,215	81	671,3	321,6	60,7	2,0	2,5
0,220	81,1	558,7	209,0	39,4	1,3	1,6
0,184	78,8	1029,3	679,6	128,2	4,3	5,4
					AVERAGE =	3,2 ± 2,3

ECIES: Cotyledon orbiculata

DRY WEIGHT = 5,3 mg.

BLANK = 349,7

DATE 29/6 DAY No. 79. LIGHT.

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,311	86,2	589,1	239,4	~~60,9~~ 45,2	1,5	1,8
0,243	82,7	511,1	161,4	~~45,2~~ 30,5	1,0	1,2
0,215	81,0	558,4	208,7	~~30,5~~ 39,4	1,3	1,6
					AVERAGE =	1,5 ± 1,2.

DATE ------ DAY NO. -----

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

DATE ------ DAY NO. -----

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Cotyledon orbiculata

DRY WEIGHT = 5,3

BLANK = 349.7.

DATE 23/4 DAY No. 12. DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,243	82,7	511,1	161,4	30,5	1,02	1,2
0,215	81,0	212,6	–	–	–	–
0,205	86,1	155,3	–	–	–	–
					AVERAGE =	0,4

DATE 19/5 DAY NO. 38. DARK

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,215	81,0	671,3	321,6	60,7	2,0	2,5
0,220	81,1	558,7	209,0	39,4	1,3	1,6
0,196.	80,1	732,3	382,6	72,2.	2,4	3,0
					AVERAGE =	2,3 ± 2,1.

DATE 24/5 DAY No. 43. DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,264	84,0	4687,8	4338,1	818,5	27,3	32,5
0,305	86,0	5280,1	4930,4	930,3	31,0	36,1
0,232	81,9	4526,4	4176,7	788,1	26,3	32,1
0,280	85,0	5005,9	4656,2.	878,5	29,3	34,5
					AVERAGE =	34,5 ± 1,8.

DRY · WEIGHT = 5,3

BLANK = 349,7.

DATE 3/5 DAY No. 50 DARK

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,276	84,5	4413, 5	4063,8	766,8	25,6	30,2
0,208	80,4	4897,2	4547,5	858,0	28,6	35,6
0,195	80,0	4007, 3	3657,6	690,1	23,0	28,8
0,222.	81.3	4914,0	4564,3	861,2.	28,7.	35,3
					AVERAGE =	32,5 ± 3,5

DATE 6/6 DAY NO. 56 DARK

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,264	84	5280,1	4930,4	930, 3	31,0	36,9.
0,174	78	4526,4	4176, 7	788,1	26,3	33,3
0,137	75	3164, 0	2814, 3	531, 0	17,7	23,6
					AVERAGE =	31,3 ± 6,7

DATE 11/6 DAY No. 61 DARK

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,232.	81,9	4526,4	4176, 7	788,1	26,3	32,1.
0,248	83	4687,8	4338,1	818,5	27,3	32,9
0,222	81,3.	5355	5005,7	944,5	31,5	38,7
					AVERAGE =	34,6 ± 8,1.

SPECIES: Cotyledon orbiculata

DRY WEIGHT = 5,3

BLANK = 349,7.

DATE 20/6 DAY No. 70 DARK

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,113	72,5	1926,96	1576,9	297,5	9,9	13,7
0,104	72,0	1702,3	1352,6	255,2	8,5	11,8
0,107	72,2.	1871,7	1522,0.	287,2.	9,6	13,3.
					AVERAGE =	12,9 + 1,0.

DATE 29/6 DAY NO. 79 DARK

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,122	73,5	1319,4	969,7	183,0	6,1	8,3
0,195	80,0	1521,9	1172,2	221,2	7,4	9,2
0,155	76,5	1646,7	1297,0	244,7	8,2	10,7
0,195	80,0	1169,0	819,3.	154,6	5,2	6,4
					AVERAGE =	8,7 ± 1,8.

DATE ------ DAY No. ------ [ ]

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Cargobrotus mellei (viii)

DRY WEIGHT = 9,57

BLANK = 44,7.

DATE 23/4 DAY No. 12 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0, 181	78,3	13 658 ,2	13613 , 5	1422 , 5	47,4	60 , 6
0,180	78,2	9 188 , 1	9143 , 4	955 , 4	31,8	40 , 7
0,158	76,7	3 355,1	3310 ,6	345, 9.	11, 5	15 ,0
					AVERAGE =	38,8 ± 22,8.

DATE 6/5 DAY NO. 25 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0, 189	79	9776 ,4	9731,7	1016 ,9	22, 6	28,6
0, 180	78,2	8428,3	8383, 6	876 ,0	19.5	24,9
0, 140	75,3	10 004,7	9960,0	1040, 8	23,1	30,7
					AVERAGE =	28,1. ± 3,0

DATE 19,5 DAY No. 38 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0, 223	81.5	2083, 9	2039 , 2	213 , 1 .	7,1	8,7
0, 216	80, 9	3445 , 4	3400 , 7	355 ,4	11, 8	14,6
0, 189	79.0	2767 , 3	2722 ,6	284, 5	9,5	12,0
0, 194	79, 9.	2558, 2.	2513, 5	262,6	8, 8.	11,0
					AVERAGE =	11,6 ± 2,5.

SPECIES: Carpobrotus mellei

DRY WEIGHT = 9,57

BLANK = 44,7

DATE 6/6 DAY No. 56 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,229	81,9	1214,8	1170,1	122,3	4,1	5,0
0,219	81,2	1296,0	1251,3	130,8	4,4	5,4
0,195	79,8	1058,4	1013,7	105,9	3,5	4,4
0,173	78	1251,3	1206,6	126,1	4,2.	5,4
					AVERAGE =	5,0 ± 0,5.

DATE 20/6 DAY NO. 30 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,216	81,0	842,3	797,6	83,3	2,8	3,4
0,243	82,6	705,9	661,2	69,1	2,3	2,8
0,216	81,0	914,6	869,9	90,9	3,0	3,7
					AVERAGE =	3,3 ± 0,5.

DATE 29/6 DAY NO. 79 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,133	74,8	45,5	0,8	0,1	0,0	0
0,140	75,3	124,0	79,3	8,3	0,3	0,4
0,133	74,8	142,7	98,0.	10,2.	0,3	0,5
					AVERAGE =	0,3 ± 0,2.

SPECIES: Camponotus mellei

DRY WEIGHT = 9.57

BLANK = 44,7

DATE 23,4 DAY No. 12 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,105	72,2	37,5	0	0	0	0
0,171	77,8	89,5	44,8	4,7	0,2	0,2
0,139	75,4	378,2	333,5	34,8	1,2	1,5
0,177	78,2	387,1	342,4	35,8	1,2	1,5
					AVERAGE =	0,8 ± 0,8.

DATE 30/4 DAY NO. 19 DARK.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,196	79,9	449,8	405,1	42,3	1,4	1,8
0,219	81,2	159,6	114,9	12,0	0,4	0,5
0,216	81,0	281,2	236,5	24,7	0,8	1,0
0,205	80,3	272,7	228,0	23,8	0,8	1,0
					AVERAGE =	1,1 ± 0,5.

DATE 6/5 DAY NO. 25 DARK

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,331	87,5	748,9	704,2	73,6	2,5	2,8
0,276	84,6	2292,3	2247,6	234,9	7,8	9,3
0,229	81,9	1241,9	1197,2	125,1	4,2	5,1
					AVERAGE =	5,7 ± 2,8.

SPECIES: Corgobromus mellei

DRY WEIGHT = 9.57 mg.

BLANK = 44.7.

DATE 19/5 DAY No. 38 DARK

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,243	82,6	4979,1	4934,4	515,6	17,2	20,8
0,195	79,8	4172,4	4127,7	431,43	14,4	18,0
0,173	78	4732,4	4687,7	489,8	16,3	20,9
					AVERAGE =	19,9 ± 1,7.

DATE 6/6 DAY NO. 56 DARK

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,229	81,9	6543,7	6499,0	679,1	22,6	27,6
0,243	82,6	5894,2	5849,0	611,2	20,4	24,7
0,331	87,5	6235,1	6190,4	646,9	21,6	24,6
					AVERAGE =	25,6 ± 1,7.

DATE 20/6 DAY NO. 70 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,173	78	4231,6	4186,9	437,5	14,6	18,7
0,180	78,2	4401,2	4356,5	455,2	15,2	19,4
0,143	75,4	3975,4	3930,7	410,7	13,7	18,2
					AVERAGE =	18,8 ± 0,6.

SPECIES: Carpobrotus mellei

DRY WEIGHT = 9,57 mg.

BLANK = 44,7.

DATE 29/6 DAY No. 79 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,219	81,2	159,6	114,9	12,0	0,4	0,5
0,140	75,3	124,0	79,3	8,3	0,3	0,4
0,216	80,9	60,2	0	0	0	0
					AVERAGE =	0,3 ± 0,3

DATE ------ DAY NO. -----

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

DATE ------ DAY NO. -----

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
					AVERAGE =	

SPECIES: Crassula fasciculans.

DRY WEIGHT = 2,85 mg.

BLANK = 53,8.

DATE 23/4 X DAY No. 12 LIGHT

45 min

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,355	88,8.	9669,5.	9615,7	3373,9298	74,9762.	84,4327
0,310	86,3.	13631,9	13578,1	4764,2456	105,8721	122,6791
0,261	83,7	8874.0	8820,2.	3094,8070	68,7735	82,1667

S.D = 22,76. AVERAGE = 96,4261

DATE 30/4 DAY NO. 19 LIGHT 30 min

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,328	87,2.	4732,3	4678,5	1641,5789	54,7193.	62,7515
0,342.	88,0.	4416,2	4362,4	1530,6666.	51,0222	57,9798
0,331	87,4	4221,7	4167,9	1462,4210	48,7474	55,7751
0,242	82,2.	4746,2	4692,4	1646,4561	54,8819	66,7663.

S.D. = 4,92. AVERAGE = 60,8182.

DATE 6/5 DAY NO. 25 LIGHT.

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,291	85,92.	5274,7	5220,9	1831,8947	61,0632.	71,6704
0,320	87.	2170,0	2116,2.	742,5263	24,7509	28,4493
0,324	87,1.	1774,2.	1720,4	603,6491	20,1216	23,1017

S.D. = 26,63. AVERAGE = 41,0738

SPECIES: Crassula fasicularis

DRY WEIGHT = 2,85 mg

BLANK = 53,8

DATE 19/5 DAY No. 38 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,264	83,9	1137,9	1084,1	380, 3860	12, 6780	15, 1108
0,264	83,9	1547,0	1493,2	523, 9300	17, 4643	20, 8156
0,315	86,7	1583, 4.	1529,6	536, 7018	17, 8901	20, 6345

S.D. = 3,24. AVERAGE = 18, 8536

DATE 6/6 DAY NO. 56 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,269	84,4	547, 0	493,2.	173, 0526	5, 7684	6, 8346
0,285	85,	367, 1	313,3	109, 9299	3, 6643	4, 3109
0,125	74.	573,6 ~~751,4~~	519,8	182, 3860	6, 0795	8, 2155
0,143	75,3.	671, 5.	617,7	216, 7368	7, 2246	9, 5944

S.D. = 2,25 AVERAGE = 7, 2389.

DATE 29/6 DAY NO. 79 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,229	81,9	68,7	14,9	5, 2281	0, 1743	0, 2128
0,248	83,1	141,2.	87,4	30, 6667	1, 0222	1, 2301
0,244	83,0	74, 9.	21,1	7, 4035	0, 2468	0, 3295

S.D. = 0,56. AVERAGE = 0, 5908

SPECIES: Crassula fasicularis

DRY WEIGHT = 2,85 mg.

BLANK = 53,8.

DATE 23/4. DAY No. 12. DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm /mg	cpm /mg /m	DPM
0,330	87.5	2170,4	2116,6	742,67	24,76	28,30
0,305	86	2048,9	1995,1	700,04	23,33	27,13
0,276.	84,5	2223,6	2169,8	761,33	25,38	30,04
					AVERAGE =	28,49 ± 10,04.

DATE 6/5 DAY NO. 25 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank.	cpm /mg	cpm/mg/m	DPM.
0,223	81.5	4562,1	4508,3	1581,9	52,7	64,7
0,137	75	4039,8	3986,0	1398,6	46,6	62,2
0,174	78	4214,7	4160,9	1459,9	48,7	62,4
					AVERAGE =	63,1 ± 1;60

DATE 19/5 DAY No. 38 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm/mg/m	DPM.
0,291	85,2	5116,0	5062,2	1776, 2	59,2	69.5
0,248	83	5482,4	5428,6	1905, 8	63,5	76,5
0,264	84	5961,8	5908,0	2073,0	69,1	82,3
0,276.	84.5	4962,3.	4908,5	1722, 3.	57,4	67,9
					AVERAGE =	74,0 ± 6,6

SPECIES: Crassula fasciculans

DRY WEIGHT = 2,85 mg

BLANK = 53,8

DATE 6/6 DAY No. 56 DARK

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,305	86	4981,8	4928	1729,1228	57,6374	67,0202.
0,280	85,0	5241,3	5187,5	1820,1754	60,6725	71,3794
0,314	87,0	5844,0	5790,2.	2031,6491	67,7216	77,8409
0,324	87,1	4642,1	4588,3	1609,9298	53,6643.	61,6123
				s.d. = 6,87	AVERAGE =	69,4632

DATE 20/6 DAY NO. 70 DARK

Ext. std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,174	78	4641,8	4588,0	1609,8245	53,6608	68,7959
0,232	81,9	4215,0	4161,2.	1460,0701	48,6690	59,4250
0,137	75.	4963,3.	4909,5	1722,6315	57,4211	76,5615
				s.d. = 8,58	AVERAGE =	68,2608

DATE 29/6 DAY NO. 79 DARK

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,223	81,5	3142,6	3088,8	1083,7894	36,1263	44,3267
0,248	83	2094,1	2040,3	715,8947	23,8632	28,7508
0,276	84,5.	2768,8.	2714,3.	952,3860	31,7462.	37,5695
				s.d. = 7,81	AVERAGE =	36,8824

SPECIES: Euphorbia mauritanica.

DRY WEIGHT = 9,2 mg.

BLANK = 90,45.

DATE 12/4 DAY No. 1 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,248	82,9	24 016,1	23 925,6	2600,6	57,8	69,7
0,314	86,8	26 141,6	26 051,1	2831,6	62,9	72,5
0,296	85,8	35 118,4	35 027,9	3807,4	84,6	98,6
0,222	81,5	22 625,0	22 534,5	2449,4	54,3	66,8
					AVERAGE =	76,9 ± 14,7

DATE 23/4 DAY NO. 12 LIGHT.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,164	77,2	18 964,2	18 873,7	2051,5	45,6	59,1
0,189	79,2	22 015,7	21 925,2.	2383,2	53,0	66,9
0,245	82,7	25 652,3	25 561,8	2778,5	61,7	74,7
0,301	86,1	19 990,0	19 899,5	2163,0	48,1.	55,8
					AVERAGE =	64,1 ± 8,4.

DATE 6/5 DAY NO. 25 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,268	84,2	11 238,0	11147,5	1211,7	40,4	48,0
0,308	86,4	10 231,5	10141,0	1102,0	36,7	42,5
0,296	85,8	11 288,2	11197,7	1217,1	40,6	47,3
0,218	81,3	10239,5	10149,0.	1103,2.	36,8.	45,2
					AVERAGE =	45,6 ± 2,5.

SPECIES: Euphorbia mauritanica

DRY WEIGHT = 9,2 mg.

BLANK = 90,5

DATE 19/5 DAY No. 38 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,262	84,1	7551,3	7460,8	811,0	27,0	32,1
0,295	85,8	6141,8	6051,3	657,8	21,9	25,6
0,243	82,6	6321,6	6231,1	677,3	22,6	27,3
					AVERAGE =	28,3 ± 3,4

DATE 26/5 DAY NO. 45 LIGHT 45 min

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,210	80,5	4294,1	4203,6	456,9	10,2	12,6
0,164	77,2	3413,6	3323,1	361,2	8,0	10,4
0,170	77,6	6302,4	6211,9	675,2	15,0	19,3
0,165	77,3	3763,8	3673,3	399,3	8,9	11,5
					AVERAGE =	13,5 ± 4,0

DATE 31/5 DAY No. 50 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,173	78	2948,3	2852,8	310,1	10,3	13,3
0,123	74	3213,1	3122,6	339,4	11,3	15,3
0,100	71,5	4343,4	4252,9	462,3	15,4	21,6
					AVERAGE =	16,7 ± 4,3.

SPECIES: - Euphorbia mauritanica

DRY WEIGHT = 9,2 mg.

BLANK = 90,5.

DATE 6/6 DAY No. 56 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm /mg	cpm /mg /m	DPM
0,258	83,6	3121,5	3031,0	329,5	11,0	13,1
0,202	79,9	3178,0	3087,5	335,6	11,2	14,0
0,155	76,7	1199,2	1108,7	120,5	4,0	5,2
					AVERAGE =	10,8 ± 4,8

DATE 12/6 DAY NO. 61 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm /mg	cpm/mg/m	DPM.
0,218	81,3	800,8	710,3	77,2	2,6	3,2
0,114	73,0	886,5	796,0	86,5	2,9	4,0
0,228	81,7	1024,7	934,2	101,5	3,4	4,1
0,282.	85,4	835,7	745,2.	81,0	2,7	3,2
					AVERAGE =	3,6 ± 0,5

DATE 16/6 DAY NO. 66 LIGHT

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm/mg/m	DPM.
0,180	78,5	317,3	226,8	24,7	0,8	1,0
0,187	79,0	348,0	257,5	28,0	0,9	1,2
0,255	83,5	344,5	254,0	27,6	0,9	1,1
0,289	85,6	497,7	407,2	44,3	1,5	1,7
					AVERAGE =	1,3 ± 0,3

ECIES: Euphorbia mauritanica

DRY WEIGHT = 9,2 mg.

BLANK = 90,5.

DATE 20/6 DAY No. 70 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,173	78	954,0	863,5	93,9	3,1	4,0
0,202	79,9	876,8	786,3	85,5	2,8	3,6
0,164	77,2	915,7	825,2	89,7	3,0	3,9
0,198	79,8	743,2	652,7	70,9	2,4	3,0
					AVERAGE =	3,6 ± 0,5.

DATE 24/6 DAY NO. 74 LIGHT

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,217	81,3	427,2	336,7	36,6	1,2	1,5
0,218	81,3	239,5	149,0	16,2	0,5	0,7
0,242	82,5	289,3	198,8	21,6	0,7	0,9
0,257	83,6	424,5	334,0	36,3	1,2	1,4
					AVERAGE =	1,1 ± 0,4.

DATE 28/6 DAY NO. 79 LIGHT.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,198	79,8	101,6	11,1	1,2	0,04	~~0,01~~ 0,1
0,246	82,8	143,4	52,9	5,8	0,2	0,2
0,222	81,5	98,3	7,8	0,8	0,03	0,0
0,202.	79,9	122,9	32,4	3,5	0,1	0,1
					AVERAGE =	0,1 ± 0,1.

Euphorbia mauritanica. DRY WEIGHT = 9,2 mg.

BLANK = 90.5.

DATE 23/4 DAY No. 12 DARK.

Ext. std.	% count. eff.	cpm.	cpm – blank	cpm /mg	cpm /mg /m	DPM
0, 308	86,2	149.6	59,1	6,4	0,2	0,2
0, 216	81.1	202,8	112.3	12,2	0,4	0,5
0,223	81.4	234,7	144,2	15,7	0,5	0,6
0,198	79,8	256,0	165,5	18,0	0,6	0,8
					AVERAGE =	0,5 ± 0,2.

DATE 19/5 DAY NO. 38 DARK.

Ext. std.	% Count. eff.	cpm.	cpm – blank.	cpm /mg	cpm/mg/m	DPM.
0,237	82.9	1261,2	1107,7	127,3	4,2	5,1
0,216	81,0	2618,9	2528,4	274,8	9,2	11,3
0,233	82,0	2815,7	2725,2	296,2	9,9	12,0
0,253.	83,3	2395,9	2305,4	250,6	8,4	10,0
					AVERAGE =	9,6 ± 3,1.

DATE 26/5 DAY NO. 45 DARK.

Ext. std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm/mg/m	DPM.
0, 106	72,1	6057,0	5966,5	648,5	21,6	30,0
0, 123	74,0	9409.5	9319,0	1012,9	33,8	45,6
0,140	75,3	9305,5	9215,0	1001,6	33,4	44,3
					AVERAGE =	40,0 ± 8,7.

SPECIES: Euphorbia mauritanica

DRY WEIGHT = 9,2 mg.

BLANK = 90,5.

DATE 6/6 DAY No. 56 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,146	75,9	10 962 ,3	10 871, 8	1181 ,7	39,4	51,9
0,223	81,4	13 672 ,0	13581, 5	1476,3	49,2	60,5
0,253	83,3	11 476 ,8	11 386,3	1237,6	41,3	49,5
0,133	74,6	12 982, 5	12892,0	1401, 3.	46,7	62,6
					AVERAGE =	56,1 ± 6,4.

DATE 11/6 DAY NO. 61 DARK.

Ext. Std.	% Count. eff.	cpm.	cpm – blank.	.cpm / mg	cpm / mg / m	DPM.
0,214	81.0	16 978,0	16 887 ,5	1835,6	40,8	50 , 4
0,226	81,6	18 009 ,2	17918 ,7	1947,7	43,3	53,0
0,248	83,0	15 671,7	15581 ,2	1693,6	37,6	45,3
					AVERAGE =	49,6 ± 3,9.

DATE 16/6 DAY NO. 66 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,196	79,7	10416 ,3	10325 ,8	1122, 4	37, 4	46,9
0,223	81,4	10978 ,5	10888 ,0	1183,5	39, 4	48,5
0,241	82,5	14123 ,0	14032 ,5	1525 ,3	50,8	61,6
0,263	83,9	11146,2	11055,7	1201, 7	40,1	47,7
					AVERAGE =	51,2 ± 7,0.

SPECIES: Euphorbia mauritanica

DRY WEIGHT = 9,2 mg.

BLANK = 90,5.

DATE 20/6 DAY No. 70 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank	cpm / mg	cpm / mg / m	DPM
0,133	74,6	4547,9	4457,4	484,5	16,2	21,6
0,176	77,9	7871,9	7781,4	845,8	28,2	36,2
0,108	72,3	7623,1	7532,6	818,8	27,3	37,8
					AVERAGE =	31,9 ± 8,9.

DATE 24/6 DAY NO. 74 DARK.

Ext. Std.	% count. eff.	cpm.	cpm – blank.	cpm / mg	cpm / mg / m	DPM.
0,146	75,9	1773,1	1682,6	182,9	6,1	8,0
0,112	72,9	3000,7	2910,2	316,3	10,5	14,5
0,159	76,7	2701,2	2610,7	283,8	9,5	12,3
0,148	76,0	2075,2.	1984,7	215,7	7,2.	9,5
					AVERAGE =	11,1 ± 2,9

DATE 29/6 DAY No. 79 DARK.

Ext. Std.	% count. eff.	cpm.	cpm - blank	cpm / mg	cpm / mg / m	DPM.
0,129	74,2	52,4	-	-	-	-
0,204	80,1	65,2	-	-	-	-
0,207	80,3	46,0	-	-	-	-
					AVERAGE =	0.

APPENDIX 2.

Percentage soil moisture of;

i) Acacia nigrescens
ii) Erica sp.
iii) Euclea undulata
iv) Euryops condolei
v) Rhus lucida
vi) Aloe littoralis
vii) Cotyledon orbiculata
viii) Carpobrotus mellei
ix) Crassula fasicularis
x) Euphorbia mauritanica

(i)

Soil Moisture

Species : Acacia nigrescens.

Day Number.	% Soil Moisture ①	% Soil Moisture ②.	Average % Soil Moisture.
1	16,5	16,3 .	16,4
12	18,3	18,2	18,3
25	9,3	10,9 .	10,1
38	2,7	3,0	2,9
45	2,5	1,6	2,1
56.	1,0	1,3.	1,2 .

(ii)

Soil Moisture

Species : Erica sp. _____.

DAY NUMBER.	% Soil Moisture ①	% Soil Moisture ②.	AVERAGE % Soil Moisture.
1	14,3	13,4	13,9
12	17,6	~~#~~ 18,2	17,9
19	16,1	16,3 .	16,2
30	4,9	4,2 .	4,6
45	2,0	2,6	2,3
50	2,2	2,0	2,1
56	2,1	2,1	2,1
61	1,0	1,3	1,2
65	1,1	0,9	1,0
70	0,9.	0,9	0,9
79.	1,3	1,0	1,2
Watered Plant (on day ~~79~~ watered) 79.	14,0	14,1.	14,1

(iii)

Soil Moisture

Species : Euclea undulata.

DAY NUMBER.	% Soil Moisture ①	% Soil Moisture ②.	AVERAGE % Soil Moisture.
1	15,8	16,5	16,2
12	18,6	18,5	18,6
25	5,2	5,9	5,6
38	2,0	2,1	2,1
45	1,0	1,6.	1,3
50	0,9	0,8	0,9
56	1,5	0,7	1,1
61	1,0	1,3	1,2
70	0,8	0,8	0,8.
79	⌀ 1,0.	0,7	0,9

(iv)

Soil Moisture

Species : Euryops condolei

Day Number.	% Soil Moisture ①	% Soil Moisture ②.	Average % Soil Moisture.
1	15,1	15,0	15,1
12	18,4	18,7	18,6
25	6,8	7,0	6,9
38	3,3	3,0	3,2
45	2,6	2.4	2,5
56	1,0	1,8	1,4
61	1,0	1,0	1,0
70	0,6	1,0	0,8
79.	1,1	0,8.	1,0.

Soil Moisture

Species : Rhus lucida.

DAY NUMBER.	% Soil Moisture ①	% Soil Moisture ②.	AVERAGE % Soil Moisture.
1	17,9	17,4	17,7
12	20, 8	19, 4	20,1
25	17,4	17,3	17,4
38	6, 4	7,4	6,9
45	4,0	4,7	4,4
50	1,9	1,8	1,9
61	1,3	1,3	1,3
70	1, 4	1, 0	1,2
79.	1,4	0,9.	1,2.

Soil Moisture

Species : Aloe littoralis.

DAY NUMBER.	% Soil Moisture ①	% Soil Moisture ②.	AVERAGE % Soil Moisture.
12	18,5	19,4	18,9
25	8,9	8,2.	8,6
38	5,5	5,8	5,7
45	5,3	4,2	4,8
61	1,2	1,6	1,4
70	1,6	0,8	1,2
79.	0,9	~~1,81~~. 1,4.	1,2.

Soil Moisture

Species : Cotyledon orbiculata.

Day Number.	% Soil Moisture ①	% Soil Moisture ②.	Average % Soil Moisture.
1	19,8	18,6	19,2
12	19,8	19,3	19,6
19	16,1	16,7	16,4
25	14,8	16,3.	15,6
38	10,1	10,4	10,3
43	8,1	8,0	8,1
45	8,0	8,0	8,0
50	5,5	5,7	5,6
56	4.8	5,6	5,2
61	1,0	1,6.	1,3
70	1,1	1,3	1,2
79.	1,4	1,1	1,3.

Soil Moisture

Species : Carpobrotus mellei

Day Number.	% Soil Moisture ①	% Soil Moisture ②.	Average % Soil Moisture.
1	18,5	18,7	18,6
12	19,0	19.7	19,4
19	17,8	16,8	17,3.
25	16,0	16,1	16,1
38	11,7	11,5	11,6
56	4,4	5,3	4,9
70	2,9	2,6	2,8
79.	1,3	1,4.	1,4.

Soil Moisture

Species : Crassula fasicularis

DAY NUMBER.	% Soil Moisture ①	% Soil Moisture ②.	AVERAGE % Soil Moisture.
1	16,4	17,2	16,8
12	19,2	18,0	18,6
19	14,3	13,9	14,1
25	10,0	9,9.	10,0
38	2,1	2,3	2,2.
45	1.5	1,2.	1,4
56	1,2	1,1	1,2
70	1,1	0,9	1,0
79.	0,9	1,2.	1,1.

(x)

Soil Moisture

Species : Euphorbia mauritanica.

Day Number.	% Soil Moisture ①	% Soil Moisture ②.	Average % Soil Moisture.
1	17,9	18,5	18,2
12	19,4	19,9	19,7
25	16,2	16,3	16,3.
38	7,8	6,6	7,2
45	4,1	4,7	4,4
50	3,6	2,6	3,1
56	2,6	2,5	2,6
61	0,8	0,7	0,8
66	1,0	1,2	1,1
70	0,9	1,32.	~~1,1~~ 1,1
74	1,4	1,4	1,4
79.	1,2	0,8.	1,0.

APPENDIX 3.

Relative water content of;

i) *Acacia nigrescens*

ii) *Erica sp.*

iii) *Euclea undulata*

iv) *Euryops condolei*

v) *Rhus lucida*

vi) *Aloe littoralis*

vii) *Cotyledon orbiculata*

viii) *Carpobrotus mellei*

ix) *Crassula fasicularis*

x) *Euphorbia mauritanica*

(i)

RELATIVE WATER CONTENT.

SPECIES : Acacia nigrescens.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	99 ~~94,52~~	100,00	97,5
25	43,18	45,10	44,14
38	22,16	18,04	20,10
45	18,97	17,03.	18,00
56.	19,24	20,02. ~~18,76~~.	19,72.

(ii)

Relative Water Content.

Species : Erica sp.

DAY Number	Relative Water content % ①	Relative H_2O Content (%) ②	Average - RW.C. (%)
12	95,24	98,18	96,71
19	63,04	59,92.	61,48
30	34,87	31,15	33,01
45	31,26	60,69.	29,42
50	26,12	31,23.	27,40
56	26,48	24,09.	25,28
61	26,39	23,69	25,04
66	26,02	23,72.	24,87
70	26,88	24,36.	25,62
79	26,12.	22,50.	24,31.

(iii).

RELATIVE WATER CONTENT.

SPECIES : Euclea undulata.

DAY NUMBER	Relative Water content % ①.	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	96,84	96, 56	96,70
25	64,39	58,26.	61,32
38	37,82	33,46.	35,64
45	30,66	35,07.	32,87
50	29.45	26,75	28,10
56	21,39	28,49	24.94
61	24.67	20,89.	22,78
70.	20,89.	21,19.	21,04.

RELATIVE WATER CONTENT.

SPECIES : Euryops condolei.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - R.W.C. (%)
12	96,24	95,36	95,8
25	80,14	84,72.	82,43
38	54,28	54,94	54,61
45	49,67	52,21.	50,94
56	49,01	44,05	46,53
61	40,01	44,99.	42,50
70	37,64	42,32.	39,98
79.	39,82.	36,78.	38,30.

RELATIVE WATER CONTENT.

SPECIES : Rhus lucida.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	98,27	100, 70.	99,49
25	85,64	80, 56	83,10
38	62, 00	58, 86.	60,43
45	47,44	~~53~~ 52, 30.	49,87
50	44.21	43,6.	43,90
61	30,87	32, 03	31,45
70.	25,71	23,31.	24,51
79.	23,82.	24,22.	24,02.

(vi)

RELATIVE WATER CONTENT.

SPECIES : Aloe littoralis.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	87,45	90,35	88,9
25	84,01	85,53.	84,77
38	63,24	67,3.	65,27
45	59,32	54,08	56,71
61	43,44	41,60.	42,52
70	35,14	38,58	36,86
79.	34,68.	37,38.	36,03.

RELATIVE WATER CONTENT.

SPECIES : Cotyledon orbiculata.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
6	90,04	92,98	91,51
# 12	82,87	84,83.	83,85
19	68,03	68,65	68,34
25	51,75	57,63.	54,69
38	40,89	41,57	41,23
43	37,62	38,50.	38,06
45	37,85	35,89	36,87
50	39.84	34,04	36,94
56	37,02	33,00.	35,01
61	30,23	34,83	32,53
70	31,19	28,93.	30,06
79.	28,06.	31, 78.	29,92.

RELATIVE WATER CONTENT.

SPECIES : Carpobrotus mellei

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	91,04	96,3	93,67
19	86,88	82,26	84,57
25	79,21	78,13	78,67
38	60,39	68,49	64,44
56	33,05	32,91	32,98
70	6,00	6,68	7,34
79.	7,89	6,63	7,26.

RELATIVE WATER CONTENT.

SPECIES : Crassula fasicularis.

DAY NUMBER	Relative Water content %. ①.	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	90, 13	92, 39	91, 26
19	78 , 45	78, 36	78, 41
25	62, 87	71, 11.	66, 99
38	57, 92	52, 10.	55, 01
45	53, 64	47, 02.	50, 33
56	42, 59	47, 5	45, 08
70	35, 68	36, 60.	36, 14
79.	27, 94.	29, 18.	28, 56.

RELATIVE WATER CONTENT.

SPECIES : Euphorbia mauritanica.

DAY NUMBER	Relative Water content % ①	Relative H_2O Content (%) ②	AVERAGE - RW.C. (%)
12	99,87	98,91.	99.39
25	95,04	97,74	96,39
38	77,82	75,22.	76,52.
45	64,31	70,17.	67,24
50	59,62	58,32.	58,97
56	46,85	49,61.	48,23
61	43,14	39,54.	41,34
66	32,70	34,86.	33,78
70	26,99	28,63.	27,81
74	17,02	17,98	17,50
79.	16,17	17,67.	16,92.