

SOME ASPECTS OF THE AUTECOLOGY OF *PANICUM TURGIDUM* FORSK

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ABSTRACT

The germination of *Panicum turgidum* seeds was tested under different conditions. They showed ability to germinate under a range of temperatures from 25-42°C. The maximum percentage of germination was 45%, at 30°C. The species responded differently to the various chemical substances used to stimulate its germination. The particular effect of each chemical substance was discussed. The percentage of seedling emergence was highest in the case of seeds sown at 0. cm depth and decreased gradually as the depth increase. The species responded widely to the various combinations of soil types and water regimes. This represented an adaptation to the severe conditions prevailing in the habitat of this species.

INTRODUCTION

Panicum turgidum Forsk is a glaucous shrubby herbaceous grass (Poaceae) up to 4 feet high. Culms are woody, solid and glabrous. The plant is many noded with very unequally long internodes frequently producing clusters of numerous short or long branches from the nodes. The leaf is variable in size, linear and tapering to a fine pungent point. Glumes are sub-equal (Andrews, 1952). The plant which is a sand binder and is continuously grazed is widely distributed in north and central Sudan (arid and semi-arid zones) and is a permanent component of the vegetation.

Panicum turgidum is a charactersitic plant of wadies throughout the Sahara and may be used as an indicator of sub-desert conditions. Tackholm, Tackholm & Drar (1941) recorded this plant in Egypt, Algeria, Morocco, Sudan, Somalia, Mauretania, Palestine, Jordan, Persia, India, India and Batanouny (1981) recorded its presence in Qatar.

The plant has two growth forms: an evergreen habit acquired in habitats with sustainable moisture resources and a summer deciduous grass remaining in dry condition for several months. *Panicum turgidum* is a remarkable drought resisting species and established plants may survive for several years without rain (Drar, 1936). According to Halwagy (1961) regeneration from stump is possible in the plant and this is important as a method of propagation for a plant that is heavily grazed by animals and intensively cut by man.

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Panicum turgidum in the Sudan occurs in quantity only in Khors where the deep, loose sandy soils deposits furnish a favourable habitat for growth. The species is a good sand binder (Smith, 1949; Kassas; Migahid and Shourbagui, 1958, 1). On the other hand Kassas (1956) noted that *Panicum turgidum* can develop in the early immature stages on a complete gravel cover. Jackson & Harrison (1958) describing the vegetation of the semi-arid area round Khartoum, pointed out that considerable areas have a surface layer of soft, windblown sand recently fixed by the perennial sand binding grasses *Panicum turgidum* and *Lasirus hirsutus* which are also dominant on sandy drainage lines. This indicates that *Panicum turgidum* can establish itself in a non-sandy habitat and the sand collects afterwards. Indeed (Tansely, 1946) pointed out that in some plant communities the gradual building up of the surface sand is mostly a physical process and only partly due to plant growth. It seems that it is not yet well known whether the plant can establish itself on a non-sandy substrate and the sand collects afterwards. Halwagy (1961) wrote "it remains to be seen whether this plant, like some sand binders, does in fact require a soft mobile subsurface for the normal vigorous growth".

The success and wide distribution of this plant species seem to indicate its ability to tolerate certain unfavourable conditions. The aim of this study to identify the more important of these conditions.

MATERIALS AND METHODS

Panicum turgidum seeds were collected from Kordofan (west central part of Sudan) in October 1978.

(1) 1. Germination Tests

- a. An investigation into the effect of temperature on the germination of the seeds. Seeds were germinated in incubators at 25, 27, 30, 38 and 42°C. For each temperature 4 replicates each of 25 seeds were sown on 9 cm diameter × 0.4 mm Whatman Seed Test filter pads moistened as necessary with deionized water. Seeds were examined daily and a seed was considered to have germinated when the radicle had emerged from the testa.
- b. The effect of certain chemical treatments on the germination of the seeds. The seeds were subjected to the treatments shown in Table 1. Each treatment included 4 replicates each of 25 seeds. The seeds were germinated on moist seed-test filter paper pads (0.4 mm thick and 9 cm in diameter) placed in petridishes of the same diameter. The filter pads were moistened as necessary with deionized water. Seeds were examined daily and those that had germinated were removed and counted. A seed was considered to have germinated when the radicle had emerged from the testa.

Table 1
Treatment of seeds of *Panicum turgidum*

Treatment	Duration	Remarks
1. Control (deionized water)	—	—
2. Sulphuric Acid (1%)	2 min	The treated seeds were then thoroughly washed with deionized water.
3. Potassium Nitrate (0.1M)	24 hr	
4. 1% Hydrogen Peroxide	10 hr	
5. Gibberellic Acid (0.1%)	2 hr	
6. Thiourea (0.05M)	24 hr	
7. 2, 4-D (Acid) 0.2 %	24 hr	
8. Chlorine Water	45 min	
9. Ethylurea (0.05)	24 hr	

c. The effect of depth of sowing

The seeds were sown at depths of 0, 1, 2, and 3 cm in a sandy soil (88.9%, 6.1% and 5.0% of sand, clay and silt respectively) in small plastic pots (6.5 cm diameter x 13 cm depth). The experiment included four replicates in a randomized block design. The pots were irrigated with water keeping the soil nearly around field capacity. The experiment was conducted in the greenhouse. Five seeds were sown per each pot and emergent seedlings were daily recorded and counted till not further emergence occurred during the last 2-3 days. The term emergence is the appearance of parts of the seedling above the soil surface (Harper & Obeid, 1967).

2. Growth Rate

Seeds from the same lot used for the previous experiments were used in this experiment. 15 seeds were sown in 7-inch clay pots filled with a soil mixture containing equal amounts of clay, sand and humus. After emergence, these were subsequently thinned to 5 plants per pot. The experiment included 3 replicates and 6 harvests arranged in randomized block design and conducted in a greenhouse. The pots were irrigated daily.

3. Soil Type and Water Frequency

Seeds from the same lot used in the previous experiments were used in the investigation. Four soil types—all collected from areas where *Panicum* was seen to be growing - were tried; and four water frequencies (regimes) were also used (Table 2). 20 seeds were sown per 9-inch clay pot

Table 2
The soil types and the water frequencies used.

Soil Type	Water Frequency*	
1. Heavy clayey soil	1. Daily watering	(water regime I)
2. Gravelly sandy soil	2. Watering every two days	(water regime II)
3. Coarse sand	3. Watering every five days	(water regime III)
4. Soft sand	4. Watering every week	(water regime IV)

*The four water frequencies are applied to each soil type

and the pots were watered daily (500 ml. of water per pot were used as a standard rate). After emergence and establishment the seedlings were thinned to 5 per pot and the water regime treatments then started. The experiment included 3 replicates x 4 soil types x 4 water regimes arranged in a randomized block design and was carried in the same greenhouse as described before. The first harvest was collected 80 days from sowing.

RESULTS

Temperature

The time-course for germination of the seeds is given in Figure 1. Seeds germinated in all the temperatures tried. The ultimate germination percentage after 6-8 days was the same in all temperatures, except 42°C at which germination was reduced. It is evident that the seeds are able to germinate better within a temperature range of 25 to 38°C. By the second day no germination occurred at 25°C, 9% was observed for the temperature 27°C, whereas all the other temperatures gave 28-31.4% germination. By the 4th day, significant differences occurred between the lowest and the highest temperatures on one hand and the medium temperatures on the other hand.

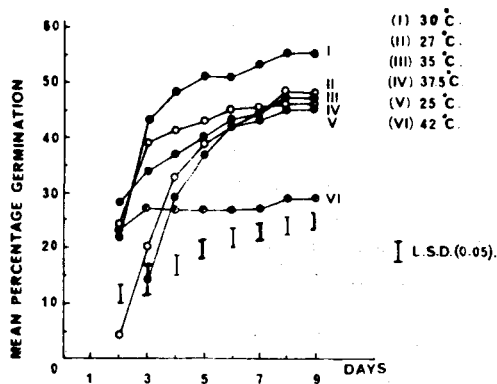


Figure 1 The effect of temperature treatment on the germination of seeds.

The effect of different chemical treatments on the germination of seeds can be seen in Figure 2.

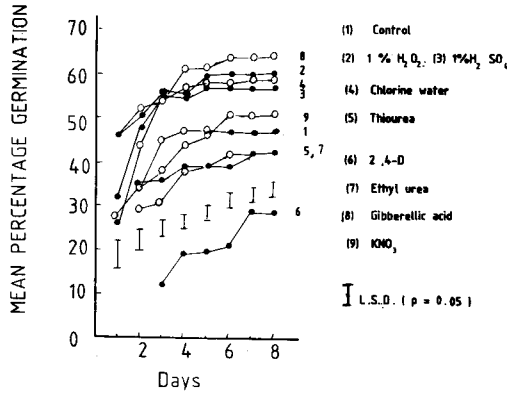


Figure 2 The effect of chemicals on the germination of *Panicum turgidum* seeds.

The Effect of Depth of Sowing

Figure 3 shows the time course of emergence of seeds at different depths. It can be seen the rate of emergence and the final percentage emergence were reduced by increasing the depth of sowing from 0-cm ($P = 0.05$) i.e. the rate of emergence was quicker from shallower depths (0-cm and 1-cm), quick from 2-cm depth and slower from the deeper depth (3-cm).

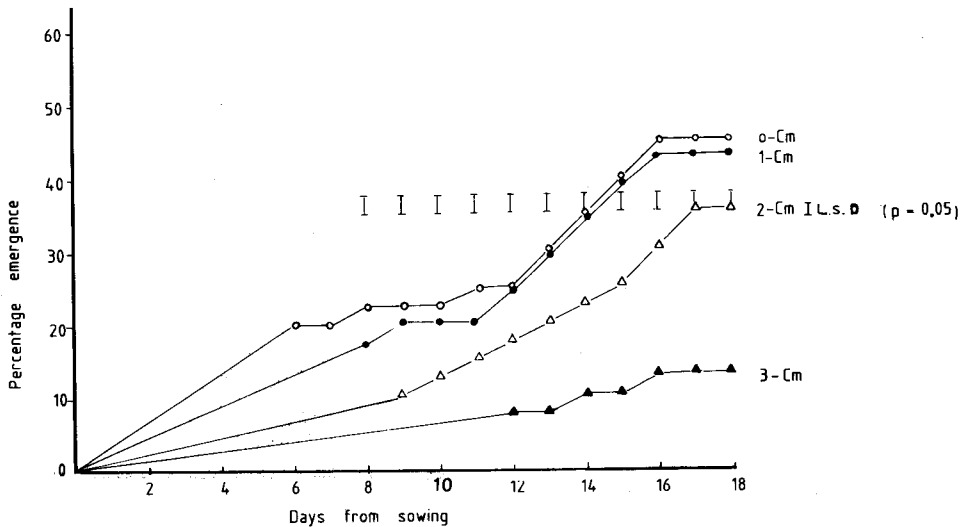


Figure 3 The sequence of seedling emergence from 0-cm, 1-cm, 2-cm and 3-cm depth of sowing.

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Growth Rate

The results are given in Figure 4. It can be seen that the plant started with a very slow rate of dry matter production especially during the first weeks but the rate increased significantly in the following weeks

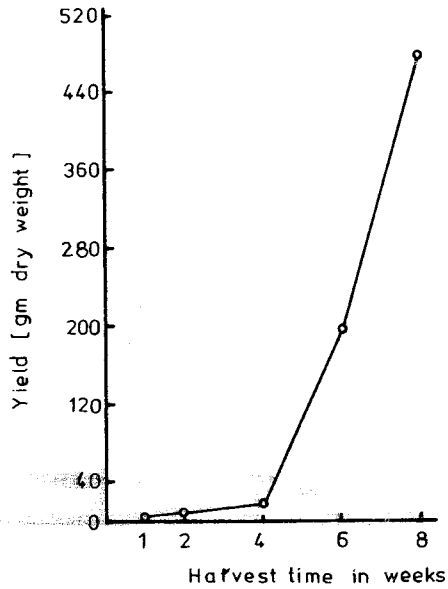


Figure 4 The growth rate of *Panicum turgidum*

Effect of Soil Type and Irrigation Frequency

The results are given in Figure 5. It can be seen that the order of dry matter production as affected by soil type and water frequency (regime) is a function of both these two factors. Thus for the various water frequencies the order of yield was as follows:

Water regime I: Clay > gravel > coarse sand > soft sand

Water regime II: Clay > gravel > soft sand > coarse sand

Water regime III: Coarse sand > clay = gravel > soft sand

Water regime IV: Clay = gravel > coarse sand > soft sand

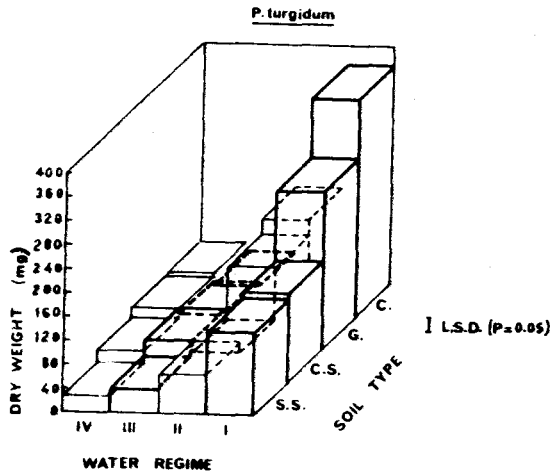


Figure 5 The interaction of soil type and frequency of irrigation on the growth of *Panicum turgidum*.

- S.S. = Soft Sandy Soil
- C.S. = Coarse Sandy Soil
- G. = Gravellous Soil
- C. = Clayey Soil

Summing the water regimes we note that the order of soil preference for this plant species seems to be clay; gravel, coarse sand and then soft sand; and for the water regimes the order of preference is I, II, III, and then IV.

DISCUSSION

It is a fact of no little significance that seeds of desert plants are continuously exposed to severe conditions. The results of the previously described experiments clearly show that *Panicum turgidum* seeds could tolerate the highest temperature applied (42°C); a temperature which quite often prevails in desert environment. Germination ability over a range of temperature (25-42°C) with a maximum percentage of germination occurring at 30° has a significant survival value. Went (1953) suggested that the temperature range permitting germination of desert plant seeds represents a thermal adaptation to their environment. Our results are also consistent with those of Batanouny & Ziegler (1971) for the seeds of *Zygophyllum coccineum* L. Mayer & Poljakoff-Mayber (1978) indicated that for many desert seeds storage at 50°C promotes germination while for the same seeds storage at low temperatures reduces germination and subsequent seedling growth.

Certain chemicals have been shown to promote germination. In the present investigation gibberellic acid gave the highest stimulating effect. The ability of the gibberellins to break dormancy of many seeds has been shown by various authors (e.g. Khan et al, 1956). Hydrogen

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peroxide is known to have an oxidizing effect on seed testa and hence its influence in promoting germination. For *Panicum turgidum* it is clear that it also has a promoting effect. The stimulatory effect of sulphuric acid on the germination of seeds of many plants has been well established (Mayer & Poljakoff-Mayber, 1978). The acid acts mainly by causing the decomposition of the seed coat components. For this plant species the acid has a profound stimulating effect but the final percentage germination has never exceeded 67%. Migahid & Shourbagui (1958, II) argued that plants like *Panicum turgidum* as weakened by overgrazing produced less viable seeds than those produced by plants protected from overgrazing. Chlorine water showed a stimulating effect on the germination of *Panicum turgidum* seeds. Williams & Harper (1965) showed that chlorates can largely replace nitrates in stimulating the germination of *Chenopodium album*. The effect of the nitrates in promoting the germination of *Panicum turgidum* seeds is significant. Leopold (1964) commented that potassium nitrate was routinely used in germination tests because of its effectiveness in promoting germination. The inhibition of the germination of the seeds of *Panicum turgidum* by thiourea in this investigation might furnish an example emphasizing the importance of very high concentrations of this chemical to be used; thiourea has been reported as it inhibited the germination of the seeds of lettuce (Mayer & Poljakoff-Mayber, 1978). 2, 4-D has a definite inhibiting effect on the germination of *Panicum turgidum* seeds. Herbicides of various kinds have been shown to inhibit germination. Misra & Patnaik (1959) have shown that 2, 4-D at various concentration has an inhibitory effect on the germination of seeds from various plant species. The inhibiting effect of ethyl urea was pointed out by Mayer (1956) for lettuce seeds.

The present results show that *Panicum turgidum* seedlings emerged from the different depths imposed. In the field the seeds of desert plants are usually buried by drifted sand (Batanouny & Ziegler, 1971). In the present study it was shown that the emergence of the seedling is optimal between 0-1 cm depth. Weaver & Clements (1938), Harper *et al* (1970), and Batanouny & Ziegler (1971) stated that there is an optimal depth of sowing for germination of each species which varies with the habitat (soil type = and the requirements of germination). Batanouny & Ziegler (1971) particularly indicated that for desert plants such an optimal depth is advantageous for the germinating seeds against the rapid desiccation of surface soil layer imposed by the prevailing desert conditions.

The results also show that although *Panicum turgidum* started with a very slow rate of dry matter production in the first four weeks yet it significantly increased after the sixth week. This substantial increase seems to be due to tillering which actually starts by the fifth week. Indeed Cooper (1951), Troughton (1965) Aspinall (1961) and Langer (1972) point out that once tillering starts tiller numbers frequently increase exponentially.

The good performance of this species in the clay soil could be attributed to the high water-holding capacity of clay. In gravel soil the species yielded well when there was enough moisture (water regime I, II). Imam (1957) observed that with the gravel-desert ecosystem the communities dominated by this species are restricted to the drainage lines. Kassas's (1956) observation that *Panicum turgidum* can develop in the early immature stages in a complete gravel cover is well supported by the behaviour of this species on the gravel soil under all the

water regimes tried. The behaviour of this species on the coarse sand soil is peculiar. Under adequate moisture conditions (under regime I, II) the gravel and clay soils outyielded the coarse sand soil by almost a 100% increase, whereas under drier conditions (water regime III) the species did better on the coarse sand than on either clay or gravel. This indicates that the species can well tolerate drier conditions in sandy habitats, a fact which conforms well with the performance of this species under natural conditions. Indeed the results can be extended to show that *Panicum turgidum* is a sand binder as it can grow in a clayey soil and binds sand or a gravelly soil and binds sand, or in a coarse sandy soil and also binds sand. By-and-large the results indicate that *Panicum turgidum* is well adapted to its living and survival in arid and semi arid zones (Halwagy, 1962a; Migahid & Shourbagui, 1958 II and III).

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دراسات بيئية ذاتية على الثمام (ابو ركبة)

أحمد محمد على اسماعيل - ميرغنى تاج السيد

يهدف هذا البحث إلى إجراء بعض دراسات على البيئية الذاتية لبنات الثمام (أبو ركبة) وهو أحد الانواع النباتية الصحراوية التابعة لفصيلة النجيليات .

ويتضمن هذا البحث دراسة صور الحياة لهذا النبات في الحقل منذ انبات بذوره حتى تكوين الازهار . كما أمكن دراسة الظروف الملائمة لانبات البذور فعرضت لمستويات مختلفة من درجات الحرارة ومن ثم بعض الكيماويات المنشطة والمثبطة للانبات .

ويمكن أن نستخلص من التجارب جميعها الآتى :

(١) يتحمل النبات مدى واسعا من درجات الحرارة .

(٢) بلغت نسبة الانبات اقصاها (٤٥ ٪) تحت تأثير درجة حرارة ٣٠° م .

(٣) وجد أن بعض الكيماويات مثل حامض الجبرليك وحامض الكبريتيك منشطة للانبات وإن الثيوريا مثبطة للانبات .

كذلك درس النبات تحت ظروف أربعة أنواع من التربة وأربعة نظم رى ، وتم تقدير الوزن الجاف فى مدد مختلفة وكانت هناك فروق واضحة ولكنها مطابقة لحالة النبات وهو فى بيئته الصحراوية .