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CONDITION AND TREND OF A DEPRESSION-TYPE HABITAT IN RAINFED DESERT RANGELANDS OF QATAR IN RESPONSE TO FERTILIZER APPLICATION

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صفات المراعي الصحراوية المروية بماء المطر في دولة قطر واستجابتها للتسميد

أسامـــه هنداوي سيـــــد

تم في هذا البحث إجراء تقييم لحالة المراعي الطبيعية المروية بماء المطر والمنتشرة في المنخفضات الصحراوية بدولة قطر . أثبتت النتائج أن إستعمال بلورات السماد المعدني الجاف المختبر بمعدل ٧٥ كجم / هكتار مرة واحدة في العام قبل حلول الموسم المطير من شأنه تحسين انتاجية المراعي لما له من أثر على زيادة القوة فوق الأرضية للعشب . وقد تمثلت هذه الزيادة في مضاعفة الكتلة النباتية القابلة للرعي ، كما انعكست على صورة زيادة معنوية في القيمة الغذائية للعشب . هذا وقد مثلت الزيادة الكبيرة في معدل تراكم المخلفات النباتية الجافة أحد الآثار المستحبة لاستعمال السماد المختبر في المراعي الصحراوية . ويجدر التنويه إلى أن استعمال السماد المختبر عند المعدل الموصى به لم يتسبب في إحداث تغيرات في التركيب البنائي الخضري للمجتمع النباتي قيد الدراسة مما يشير إلى عدم حدوث تأثيرات بيئية غير مرغوب فيها من شأنها تغيير التنافس بين الأنواع النباتية القاطنة لهذه المنخفضات الصحراوية .

Key Words: Desert ranges, Fertilizers, Primary productivity.

ABSTRACT

Characteristics of a rainfed depression-type habitat in desert ranges, and its response to fertilizer application were studied. A single fertilizer application at a rate of 75 Kg ha^{-1} prior to the rainy season improved range productivity by enhancing forage above-ground vigour. This enhanced vigour was manifested by a two-fold increase in the total grazable phytomass, and was reflected in increased forage nutritional value. Consequent accumulation of a greater amount of plant community litter represented a favourable implication of range fertilization. The recommended fertilizer application did not affect the vegetative composition of the studied community, and hence did not impose ecological unfavourable impact.

INTRODUCTION

Pastoralism has, for a long time, been a traditional practice in Qatar. However, overgrazing, land disturbances for roadways, and lack of planned range management resulted in deterioration of desert ranges [1]. In recent years, herds of camels and sheep are being raised on alfalfa growing in farms, but increased demand for domestic livestock dictated exploration of renewable natural resources of rainfed ranges in desert depressions. Despite mineral deficiencies in the soil [2], these depressions have been shown to possess a high grazing potential as they support a great variety of palatable plant species [3]. Moreover, soil nutrient deficiency in such semi-arid ecosystems limits forage production, and can modify vegetation composition [4,5]. Applica-

tion of fetilizers to range and pasture in such habitats is, therefore, a major aspect of range management, and is known to increase annual-plant range rediness and grazing capacity [6,7].

The terms range condition and range trend are used to express the specific characteristics (condition), and the induced changes (trend) for a vegetation unit at a given moment in time [8,9]. The present study aimed at assessing range condition in rainfed desert depressions, and involved thorough description of both amount and distribution of rainfall. Range condition was assessed in a long protected natural reserve in order to gain an insight of the vegetation composition and productivity without heavy grazing. Experiments were designed to assess range trend in response to an economic single fertilizer application prior to the rainy season. Moreover, broadcasting on the soil surface was chosen as the method of application of the tested granular fertilizer so as to simulate possible future airborne broadcasting that might facilitate treatment of areas inaccessible to ground machinery.

MATERIALS AND METHODS

The experiment was carried out in a well-protected site located at a natural reserve 30 KM west of Doha. The study site was a typical desert depression of the type made through various erosinal processes [1]. Quadrates (1 m^2 each) were randomly marked in mid-October before the start of the rainy season. A nitrogen-phosphorus-potassium (NPK) granular fertilizer containing 12% ammonium nitrate, 12% P_2O_4, 17% K_2O, and 2% MgO that is readily available at the local market (National Industrial Co., Qatar) was used in the experiment. Broadcasting of the fertilizer on the soil surface at the rates of 50, 75, and 100 Kg ha^{-1} was delayed to mid-November to avoid excessive volatilization and loss of ammonia [7]. Ten quadrates were used for each treatment, and ten untreated quadrates were used as control. Records of rainfall were kindly supplied by Doha Airport Meteorological Station (Ministry of Communication and Transport). All quadrates were left to receive precipitation, and were monitored at monthly intervals for observation the emerging winter annual species. Density of plant cover (DPC) was estimated using 10 cm^2 grid [10] in mid-March, the time of flowering of most recorded species [1]. Plants growing in five quadrats of each treatment were then destructively harvested, separately freeze-dried, and dry weights of the total grazable phytomass (TGP) were determined. Dry plant materials of each treatment were then mixed, ground to pass 0.5 mm mesh sieve, and were used as composite samples for the determination of grazable nonstructural carbohydrates (GNC), insoluble crude fibres (ICF), total crude protein (TCP), ether extractable fraction (EEF), and total ash (ASH) using protocols recommended by the British Ministry of Agriculture, Fisheries, and Food (1981). Dry litter was collected from the remaining quadrats in mid-May, and the total community litter (TCL) was determined. All procedures were routinely repeated and data were expressed as mean ± standard error mean.

RESULTS

Records of rainfall showed that the average annual precipitation (mean of 20 years) amounted to 75.6 mm. This precipitation is confined to a rainy season that extends from October to May, with the period June to September being virtually rainless. These records also showed that February was the wettest month, with a mean precipitation value of 23.4 mm. Mean monthly precipitation values were 20.4 mm, 9.2 mm, 6.7 mm, 4.8 mm, and 9.2 mm, for January, March, April, November, and December, respectively. Precipitation in early autumn (September), and late spring (May) proved to be ineffectual.

Survey of vegetation showed that *Francoueria crispa* and *Pulicaria undulata* were the only grazable perennial plant species recorded at the start of the experiment (Table 1). Survey of vegetation in mid-March showed the presence of twelve grazable annual plant species belonging to seven families, namely Asteraceae, Caryophyllaceae, Convolvulaceae, Fabaceae, Lamiaceae, Plantaginacea, and Poaceae (Table 1). This survey also showed that DPC decreased in the order Fabaceae > Poaceae > Plantaginaceae > Other families (Fig. 1), indicating that the site contained a grass-legume dominated population.

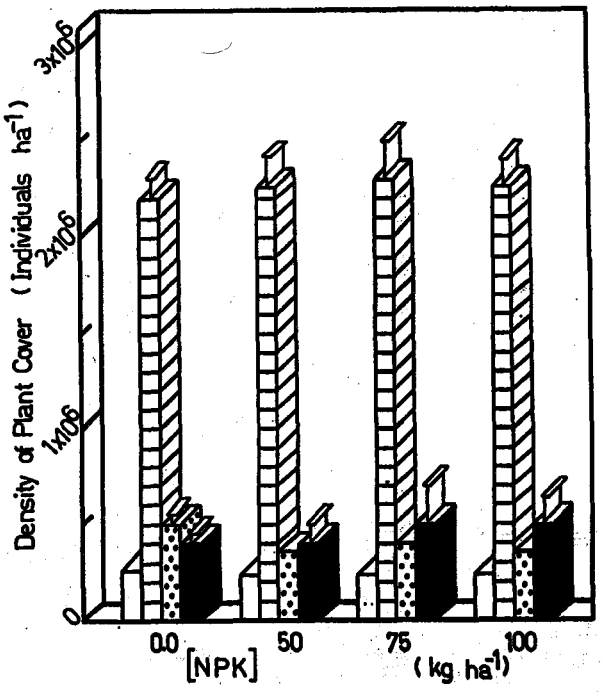

Fig. 1: Density of plant cover as affected by application of different rates of the tested NPK-fertilizer (❑ Asteraceae, ▤ Fabaceae, ▩ Other families, ■ Poaceae (± SE, n= 5).

Table 1

Growth habit (GH), life form (LF), and flowering time (FT) of the grazable plant species recorded at the study site, P = Perennial, WA = Winter annual (References 1,3)

Species	GH	LF	FT
ASTERACEAE			
Francoeuria crispa (Forrsk.) Cass	P	Forb	All Year
Launea capitata (L.) Hook. f.	WA	Forb	February
Pulicaria undulata (L.) Kostel	P	Forb	All Year
CARYOPHYLLACEAE			
Polycarpae spicata Wight ex Arn.	WA	Forb	March
Herniaria hemistemon J. Gray	WA	Forb	February

Table 1 Contd.

Growth habit (GH), life form (LF), and flowering time (FT) of the grazable plant species recorded at the study site, P = Perennial, WA = Winter annual (References 1,3)

Species	GH	LF	FT
Convolvulus deserti Hochst et Steud	WA	Forb	March
Convolvulus prostratus Forssk.	WA	Forb	March
FABACEAE			
Trigonella hamosa L.	WA	Forb	March
Trigonella stellata Forssk.	WA	Forb	February
LAMIACEAE			
Salvia aegyptiaca L.	WA	Forb	March
PLANTAGINACEAE			
Plantago amplexicaulis Cav.	WA	Forb	March
POACEAE			
Stipa capensis Thumb	WA	Forb	March

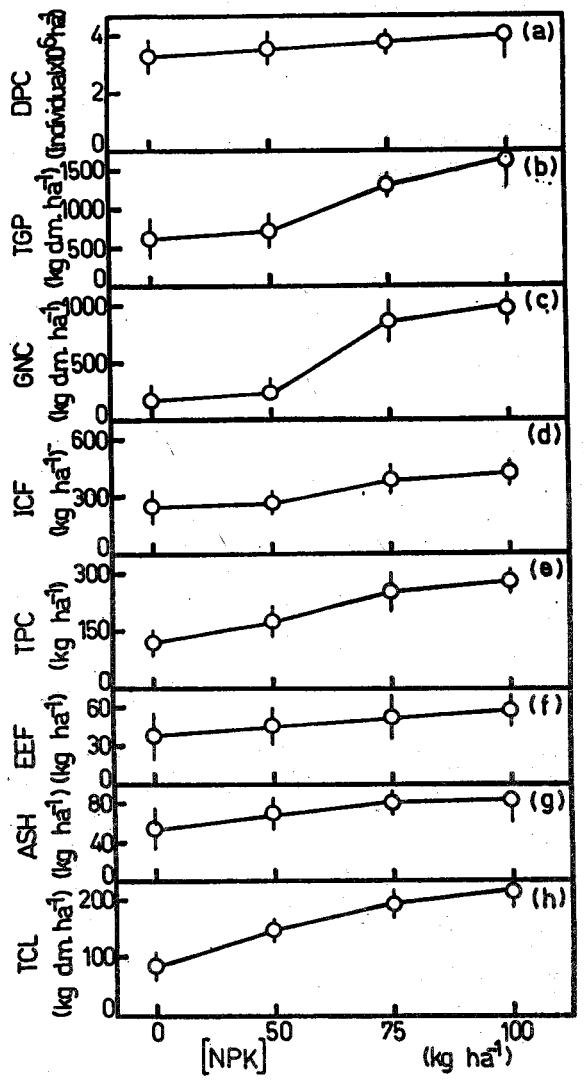

Fig. 2: Density of plant cover (a), total grazable phytomass (b), grazable nonstructural carbohydrates (c), insoluble crude fibres (d), total crude protein (e), ether extractable fraction (f), total ash (g), and total community litter (h) of the studied desert depression-type rangeland as affected by different rates of the tested NPK-fertilizer (± SE, n= 5).

Fertilizer application at all levels tested did not induce any appreciable changes in vegetation composition (Fig. 1), and DPC (Fig. 2a). Contrary to application at 50 Kg ha^{-1}, higher levels of 75, and 100 Kg ha^{-1} significantly increased TGP (Fig. 2b). This effect was also true for the forage nutritional components: GNC, ICF, and TCP (Fig. 2c-e). Nevertheless, no significant changes in forage EEF, and ASH were observed (Fig. 2f,g). Litter accumulation increased with the increase of the rate of fertiliser (Fig. 2h). It is also worth noting that changes brought about by treatments at 75 and 100 Kg ha^{-1} were not significantly different.

DISCUSSION

The desert environment of Qatar exhibits well-defined land forms, and is characterized by the presence of several hundred depressions of depths ranging from a few hundred meters to 3 Km [1]. These desert depressions are bordered by elevated rocky ridges that enhance surface runoff, and despite mineral deficiency in the soil [2] they have been shown to be richest in vegetation among other land forms of the local relief [3]. The average annual precipitation of 75.6 mm encouraged the emergence of a palatable winter annual grass legume population (Table 1).

Application of the tested NPK-fertilizer at 75 Kg ha^{-1} resulted in a two-fold increase in grazable phytomass (Fig. 2b). Such improved forage production by fertilizer application has long been recognized in desert grasslands and semi-arid pasture [4,5, 12, 13]. Increased forage contents of non structural carbohydrates, fibres, and proteins (Fig. 2c-f) occurred without affecting the density of plant cover (Fig. 2a), indicating an enhanced forage vigour. Similar results have previously been reported with nitrogen fertilizers [5, 14, 15]. Nitrogen-phosphorus mixtures have also been reported to maximize above-ground energy fixation [16]. Increased total community litter (Fig. 2h)represented another favourable implication of fertilizer application as it is expected to replenish the soil through biodegradation of its components [7]. Moreover, high levels of nitrogen fertilizers have been reported to stimulate grasses and depress legumes in grass-legume pasture [17]. However, the observed increased forage vigour occurred without such alteration of vegetation composition (Fig. 1), indicating that the grass legume competition was not affected. It can, therefore, be concluded that application of the tested fertilizer at 75 Kg ha^{-1}, in years with an ample precipitation can maximize the productivity of desert rangelands. Furthermore, the range trend responses to fertilizer application at 100 Kg ha^{-1} were not significantly different from those in response to 75 Kg ha^{-1}, indicating that the use of the latter level is recommended as being more economical. It is also recommended to carry out large scale experiments of airborne broadcasting to assess the benefits to areas inaccessible to ground machinery.

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