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Effect of Plant Fiber-Polyacrylamide Blend on Retention and Evaporation Water at Arid and Semi-Arid Soils of Algeria

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Abstract: Soil and water conservation is essential for sustaining food production and for preserving the environment in arid and semi arid lands (ASALs) where conditions for agriculture and other land use systems are often harsh and unpredictable. The ASALs of Algeria are an important source of a variety of non wood forest products like *Stipa tenacissima* L. plant (esparto grass). This research was conducted to determine the effects of different low concentration (< 1%) polyacrylamide, *Stipa tenacissima* L. fiber (esparto grass fibers) and its mixtures with the polymer at water retention in arid and semi arid soil. All samples are characterized by infrared spectroscopy, X-ray Diffractometry, thermal analysis TG DSC and scanning electron micrographs (SEM). The results showed that polymer blend in soil could improve better soil physical proprieties decreased evaporation and increase water retention in arid soils compared with application of any other blend at the same concentration. The use of Polyacrylamide-Cellulose blend appears to promise for reducing the labor cost of irrigation at arid and semi-arid soils, and offers safe and environmentally friendly inexpensive materials. The importance of Polyacrylamide-Cellulose blends to alleviate poor physical properties and retain water in these arid regions to sustain plant growth.

Key words: Natural fiber, plant fiber, arid and semi arid regions, polymer, *Stipa tenacissima*.

1. Introduction

Soils are one of the most essential natural resources for humans. Sandy soils have two major problems: i.e. low fertility and inadequate water retention.

Arid lands have always been important to world's human population, but their significance has increased over the past few decades because of growing population and continued use of natural resources [1]. In view of the limited water resources, there is a growing need to conserve soil water in arid lands; evaporation and deep percoloration are the dominant form of soil water loss, particularly under extremely hot arid conditions such as those prevalent in Algeria.

In recent years, increasing attention has been paid to the use of renewable resources particularly of plant origin keeping in views the ecological concerns, renew ability. Alfa grass (*Stipa tenacissima* L.) is a tussock grass widely distributed in semi-arid and arid regions, in North Africa [2]. This perennial grass, also named Esparto grass, is used as a main source of fiber for making paper [3]. In North Africa, the esparto grass constitutes an essential element of fight against the turning into a desert and an essential factor of the maintenance of balance pastoral.

Polymers and biopolymers have long been

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recognized as viable soil conditioners, because they stabilize soil surface structure and pore continuity.

Therefore, a number of measures are being developed to protect agricultural lands. One of these measures is the use of a number of soil conditioners and polymers on soils. Polymers solutions can be used for reducing soil erosion such as polyvinyl alcohol (PVA) [4]. Soil conditioners have been reported to be effective tools in increasing water holding capacity, reducing infiltration rate and cumulative evaporation, and improving water conservation of sandy soils. In arid and semiarid regions, there is an increasing interest in using water-saving super absorbent polymer (SAP) as water-retaining materials in the agricultural and for field crop production [5]. Polyacrylamide was effective in enhancing the stability of soil aggregates [6], and increasing soil infiltration in some areas especially in sandy loam soils [7-8]. Polyacrylamide is a long-chain synthetic polymer that acts as a strengthening agent, binding soil particle together and holding soils in place, but polyacrylamide alone don't remediate poor soil structure [9]. The general objective of this study is to produce a series of low costs polymers and biopolymers to alleviate some poor physical properties of sandy soils such as low water retention and inefficient water use, especially in arid and semiarid regions such as in Algeria conditions. The main idea of this paper is to use natural fibers, such as Alfa fibers and polyacrylamide to make a good economic blend material to retain water at arid and semi arid soils in Algeria.

2. Materials and Methods

Acrylamide (E.MERCK) was purified by crystallisation from hot methanol; crystals are separated by filtration and then desiccated under vacuum at 30 °C. Potassium persulfate (99.9%) was purified in the same manner. Water was used as solvent and bidistilled from $KMnO_4$ before used.

Methanol 215 (Romil-SPS 99.9 %);

Ethyl benzene (Carlo Erba, chimica Milano);

Toluene (BDH chemical LTD);

Acetone (Romil-SA);

Benzoyl peroxide (98%) (Sigma-Aldrich);

All other reagents were used as received.

2.1 Preparation of Polyacrylamide (PAM)

The method used for the polymerisation reaction was proposed by Shultz [10]. Polyacrylamide was prepared by radical polymerisation in aqueous solution with acrylamide as monomer (8 g dissolved in 260 mL of bidstilled water), potassium persulfate $K_2S_2O_8$ (0.4 g dissolved in 10 mL of distilled water) as initiator; the reaction lasted for 5 hours at constant temperature (50 °C) under inert anhydride nitrogen. Vigorous stirring ensured homogeneous conditions by RW 20 IKA-WERK motor. The polymer solution obtained was concentrated by "Rota vapor" (1/3 of initial volume), then it precipitated in methanol (V/V, 1/7) and filtered-on Buchner. The obtained Polyacrylamide was cleaned by dissolving it in bid stilled water then precipitated second time in methanol to eliminate all initiator and monomer traces and filtered on Buchner, desiccated using inert nitrogen atmosphere under vacuum at 30 °C.

2.2 Plant Samples and Analysis

2.2.1 Plant Samples

The raw material having been the subject of our study comes from the Algerian steppe region. Plant materials must be clean and free of extraneous substances including soil and dust particles that may influence analytical results. For analyses of esparto grass we prepared approximately 10 g of finely crushed plant with particles of homogeneous size, sifted on sieve n° 24 and n° 27.

2.2.2 Extraction of Cellulose from Esparto Plant

Alfa fibres are cellulose-based fibres extracted from the esparto grass. The cellulose was extracted from Alfa plant with 400 mL toluene/ethanol mixture (2/1, V/V) for 6 hours using Soxhlet apparatus and treated with NaOH (1 M) for 8 hours at 25 °C [11-12]. After filtration the cellulose was obtained and the filtrate contains the lignin and hemicelluloses.

2.2.3 Plant Analysis

The concentration of nutrients in plant tissues was measured in a plant extract obtained from fresh plant material. Plant samples were washed in distilled water, oven dried at 60 °C for 48 h, weighed, and then ground to 0.1 mm before chemical analysis. To determine the organic, mineral and dry matter the elemental analysis was used.

2.3 Soil Sampling and Analysis

2.3.1 Soil Sampling

Two soils from Algeria were chosen for this study: arid soil (S1) from Biskra and semi arid soil (S2) from Batna. Soil samples were taken from the surface layer (0-20 cm) and were analyzed using standard analytical methods [13-15]. Soil Specimen was treated with PAM polymer.

2.3.2 Soil Analysis

Soil samples were collected and taken to the laboratory for chemical and physical analysis. The bulk soil samples were air dried, crushed with a mortar and pestle, and sieved to remove coarse (> 2 mm) fragments. Particle size distribution was determined by the hydrometer method.

2.4 Preparation of Blend and Composites Polymers

(Polyacrylamide-Cellulose) blend was prepared by dispersing cellulose fibres in polyacrylamide. The solution was sonicated for various times between 10 and 15 minutes using ultrasonic apparatus. Polymer blend was applied at soil surface in different concentrations (Table 1).

Table 1 Synthetic details of blend and composites (polymers with soil).

Sample polyacrylamide (%)	Soil type	N° (%)	Cellulose (50 g)
1	Arid	0.5 g/L (1%)	15 mg/L (0.03%)
2	Arid	0.5 g/L (1%)	0 mg/L
3	Arid	0 g/L	15 mg/L (0.03%)
4	Semi Arid	0.5 g/L (1%)	15 mg/L (0.03%)
5	Semi Arid	0.5 g/L (1%)	0 mg/L
6	Semi Arid	0 g/L	15 mg/L (0.03%)

2.4.1 Sampling and Evaporation Measurement

The artificially simulated evaporation experiments have been conducted for arid and semi arid soil at laboratory. Surface soils (0-30 cm) samples from arid and semi-arid regions were used for evaporation experiment.

2.4.2 Measurement of Infiltration

Soil water cumulative infiltration affects the environment by controlling the irrigation rate and consequently the water movement through the ground. In order to study the cumulative infiltration in a sandy soil sample, experiments were performed in the laboratory.

2.4.3 Infiltration Rate

In the infiltration experiment, air dried < 2 mm sieved soil samples: sandy and clay soils with control and treated samples were packed at the same bulk density of 1.5 g/cm^3 bulk density in PVC columns (5 cm i.d, 60 cm long). Blend of PAM-cellulose fibre (15 mg/L Polyacrylamide and 0.5g /L Cellulose) in 20 mL water was mixed with the upper 0-2 cm of the soil columns. A flooding apparatus (Marriott Device) was used to obtain accurate infiltration data as a function of time (to maintain a constant head of 2.5 cm over the soil surface by means of a bubbler tube).

Observations made during the infiltration included change in the Marriott tube reading (cumulative infiltration) and the visible wetting front advance. When the wetting front reached 40 cm depth below the initial level of soil surface, infiltration was terminated. The procedure adopted was similar to that reported elsewhere [16].

2.4.4 Measurement of Evaporation and Experimental Procedure

For evaporation experiment we used two surface soils (0-30 cm) from arid and semi arid regions: sandy soil (S_1), and clay soil (S_2). The soils samples were in air dried passed through a 2 mm sieve and packed at the bulk density of 1.5 g/cm^3 into PVC columns (5 cm internal diameter, 35 cm long). The column was packed up to 30 cm with untreated soil and then with (0, 2, and

5 cm) of treated soil with different predetermined concentrations of polyacrylamide (15 mg/L) and half a cellulose fiber (0.5 g/L cellulose) as motioned before (each treatment was replicated three times). The soil columns were exposed to evaporation at constant room temperature (30 °C). 22 mL of tape water was added to soil columns weekly for three wetting/drying cycles. Cumulative evaporation against time was measured daily by weighing each soil column. To determine latent evaporation, the same columns were used in the soil experiments filled with water, with the same procedure of weighing and calculation [17].

2.5 Characterisation

Polymers and composites were characterized by elemental analysis, IR spectroscopy, thermal analysis, scanning electron micrographs (SEM), and X-Ray Diffractometry (XRD).

2.5.1 Elemental Analysis

To determine the organic, mineral and dry matter of Alfa-Alfa plant we used the elemental analysis.

2.5.2 FTIR Analysis

FITIR spectra were recorded on Perkin-Elmer-Paragon 500 FT-IR spectrophotometer in the range from 4000 cm^{-1} to 400 cm^{-1}. Using thin film by solution casting via air evaporation and KBr pellets for sample preparation, the thin films were prepared by casting polymers solutions on glass plates.

2.5.3 Thermal Analysis

Thermal analysis was carried out with Mettler TA TC 11 thermal analyser. Both thermo gravimetric analysis (TGA) and differential scanning calorimetry (DSC) of all samples were performed up to a temperature of 600 °C, starting from room temperature in nitrogen atmosphere. A heating rate of 10°/min was maintained in all cases and flow rate of 30 mL/min nitrogen.

2.5.4 X-Ray Diffractometry (XRD)

Polymer samples were subjected to XRD analysis, the powdered polymer sample was packed into a hole of 2 mm diameter in a small container made of perplex about 1.5 mm thick. A PW 1830 diffract meter and P3020 X- Ray generator (Phillips, Holland) were used for this study producing CuKα radiation. The scattering angle (2θ) was varied from 10 to 45°.

2.5.5 Scanning Electron Microscopy (SEM)

SEM micrographs were taken using Philips XL20 (Philips analytical Inc., the Netherlands). Samples were coated by gold before examination (cathode dispersion).

3. Results and Discussion

3.1 Plant Analysis

After extraction and bleaching esparto grass, raw material composition and mineral components of esparto grass are given in Table 2 and Table 3, we obtained cellulose fiber showed in Fig. 1.

Table 2 Raw material composition of esparto grass.

Composition	% of dray plant
Dry Matter	94.25
Organic Matter	17.78
Mineral Matter	1.22
Extracted with ebullient water	4.06
Crude fiber	28.75
Cellulose rate	33.81
Lignin rate	18.20
Ash cotenant	5.75
Silica	2.03
Moisture	12.30

Table 3 Mineral components of esparto grass ashes.

Element	%
SiO_2	32.5
CaO	7.25
MgO	2.40
K_2O	1.32
Na_2O	0.40
P_2O_5	0.60
Fe_2O_3	2.6

Losses on the ignition = 48.23% at 1100 °C.

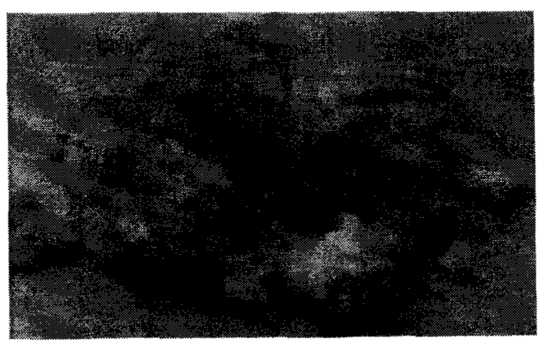

Fig. 1 Cellulose fiber obtained from esparto grass.

The fibers were used to prepare polymer blend for soil treatment.

3.2 Humidity Uptake by Esparto Fiber

Percentages of humidity Esparto fibres absorption were found 67% at 25 °C.

3.3 Soils Analysis

Selected physical and chemical proprieties of soils are given in Table 4 and Table 5.

Clay soil had higher amount of organic mater content than sandy soil.

3.4 Mineral Compositions of Soils

Concentration of different elements for both arid and semi arid soils were summarized in Tables 6-8.

3.5 Polymers Analysis

3.5.1 Cellulose FTIR Spectra

In cellulose FTIR spectrum we can see a broad absorption band at 3274 cm^{-1}, characteristic for OH groups stretching, a thinner band at 2914 cm^{-1}, characteristic for C-H stretching vibration, a band centred at 1429 cm^{-1}, assigned to CH_2 vibration (Fig. 2).

Table 4 Physical and chemical proprieties of arid soils (S_1).

Composition	Proprieties
S	74.52%
(C+Si)	25.48%
$CaCO_{3T}$	5.17%
MO	0.50%
EC (mS/cm)	0.23
CEC (meq/100 g soil)	3.2
pH	7.48
Soil textural class	Sandy

Table 5 Physical and chemical proprieties of semi arid soils (S_2).

Composition	Proprieties
C	36.18%
(C+Si)	19.72%
$CaCO_{3T}$	15.94%
CO.S	24.34%
f.S	13.61%
CO.Si	6.15%
MO	3.2%
EC (mS/cm)	0.52
CEC (meq/100 g soil)	30.8
pH	7.24
Soil textural class	Clay

S: sand; C: clay; Si: silt; $CaCO_{3T}$: total carbonate; EC: electrical conductivity; OM: organic matter content; CEC: cation exchange capacity; CO: coarse; CO.S: coarse sand; CO.Si: coarse silt; f: fine; f.S: fine sand.

Table 6 Exchangeable cations of semi arid soils and arid soils (meq/100 g).

Element	Semi arid soil	Arid soil
Ca^{2+}	17.15	42.37
Mg^{2+}	0.74	1.88
Na^{+}	0.41	0.83
K^{+}	0.26	0.12
Gypsum	-	35.75

Table 7 Exchangeable anions of arid soils (meq/L).

Element	concentrations
SO_4^{2-}	38.63
Cl^{-}	1.41

Table 8 Concentration of nitrogen and phosphor.

Element	Semi arid soil	Arid soil
Phosphor	320 ppm	Trace
Nitrogen total	0.5	0.029

3.5.2 Polyacrylamide Spectra

The FTIR spectrum of PAM is characterized by the absorption band at 3360 cm^{-1} for NH group, two strong bands around 1670 cm^{-1} and 1633 cm^{-1}, due to C=O and NH, 1724 cm^{-1} free acid group, 1398 cm^{-1} and 2930 cm^{-1} are for C-N and C-H vibrations, and finally at 1449 cm^{-1} for CH_2 group (Fig. 3).

IR spectra of arid soil treated with (Polyacrylamide-Cellulose): It showed absorption bands of 659-1000 cm^{-1} indicated the presence of (C=C-H bending); the bands of 1008.8-11842 cm^{-1} were (C-O, C-N stretching); bands of 1427.2-1473.5 cm^{-1} indicated the presence of (C-H bending); the bands of 1620.1-1790.6 cm^{-1} were (C=O, C=N, C=C stretching); band at 3242.1 cm^{-1} was due to OH group, bands of 3487.1-3404.1 cm^{-1} were due to (N-H group), we can see OH free group at 3544.9-3616.3 cm^{-1} (Fig. 4).

IR spectra of semiarid soil treated with (Polyacrylamide-Cellulose): As shown in Fig. 5, Band at 3622.1 cm^{-1} indicated the OH group, absorption band at 3409.9 cm^{-1} was due to N-H group. Absorption at 1421.4 cm^{-1} indicated the presence of C-H bending, bands from 873.7-993.3 cm^{-1} indicated the presence of C=C-H

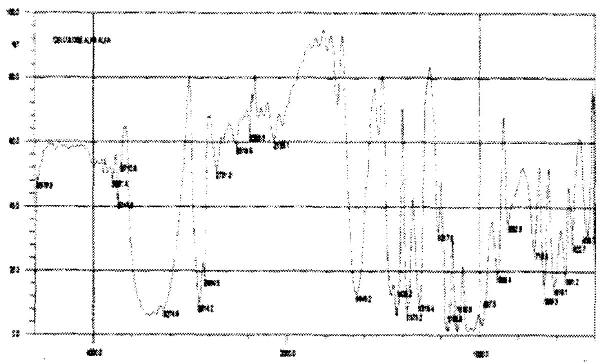

Fig. 2 FTIR spectrum of Cellulose fibres with KBr.

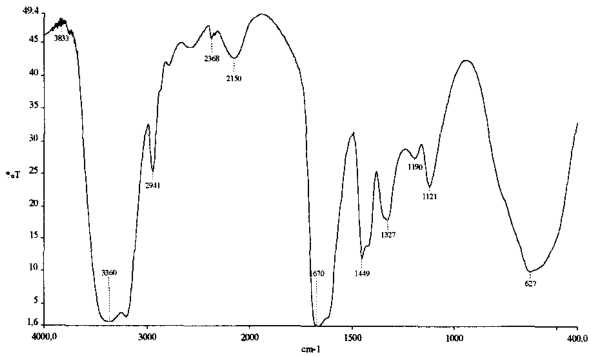

Fig. 3 FTIR spectrum of Polyacrylamide (PAM) Film.

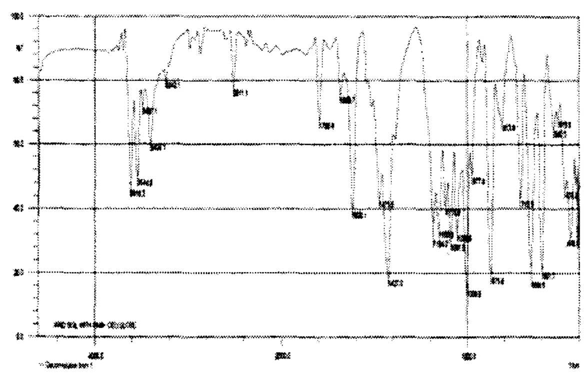

Fig. 4 FTIR spectrum of arid soil with Polyacryalamide-Cellulose in KBr.

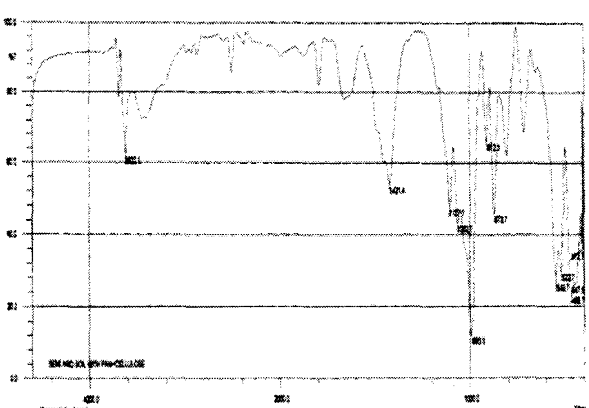

Fig. 5 FTIR spectrum of semiarid soil with Polyacryalamide + Cellulose in KBr.

bending, 1062.7-1107.1 cm^{-1} bands were due to C-O, C-N stretching. The results of IR spectrum of arid and semi-arid soil indicated that the soils are composites consisting of Cellulose and the polymerized Polyacrylamide solution.

The specific absorption bands at 1650 cm^{-1} corresponding to C=O group (amide) and 1600 cm^{-1} Corresponding to N-H are found in the blend of (polyacrylamide-cellulose) demonstrating that polyacrylamide-cellulose reaction took place at soil surface.

3.6 Thermal Analysis

3.6.1 Thermo Gravimetric Analysis (TGA)

Before studying the thermal effects on these polymers, thermal stabilities and degradation patterns were determined by employing TG and DTA. To examine the thermal stability of Polyacrylamid, and Cellulose Alfa-Alfa, Thermo gravimetric analysis under nitrogen flow was obtained.

3.6.2 Cellulose TGA Curve

Initial weight loss at 70 °C is due to the presence of small amount of moisture in the sample, the second loss is due to the loss of CO_2 and the rate of weight loss increased with increase in temperature till degradation at 350 °C (Fig. 6).

3.6.3 Polyacrylamide TGA Curve

The initial weight loss is followed by a continuous weight loss with increasing temperature, the PAM decomposes in 2 stages, the polymer starts to degrade at 270 °C followed by a second stage commencing at 390 °C degradation is due to the loss of the NH_2 group in the form of ammonia (Fig. 7).

3.6.4 TGA Curve of Arid Soil

First weight loss at 50 °C can be probably due to humidity and the second deep weight loss at 150 °C can represent the decomposition of some minerals salts (calcium sulphate) then the curve is stable (Fig. 8).

3.6.5 TGA Curve of Semiarid Soil

The first weight loss at 60 °C can be due to water loss and then small weight losses at 410 °C and 470 °C can represent the TGA decomposition (Fig. 9).

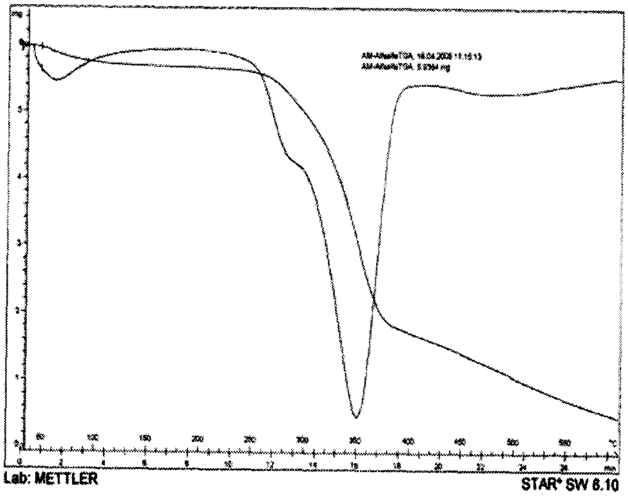

Fig. 6 TGA curve of Cellulose Alfa-Alfa.

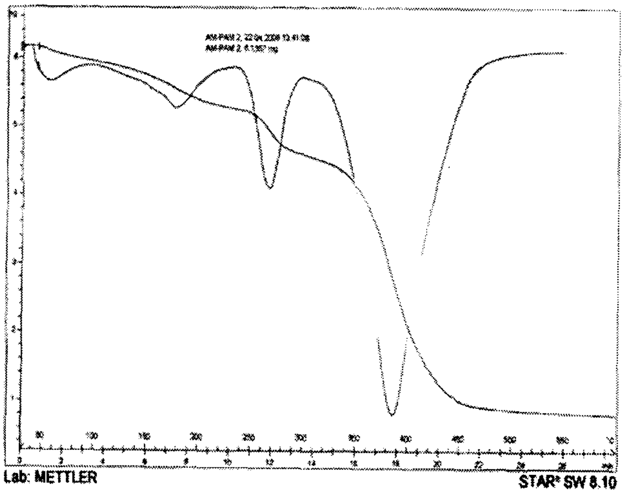

Fig. 7 TGA curve of PAM.

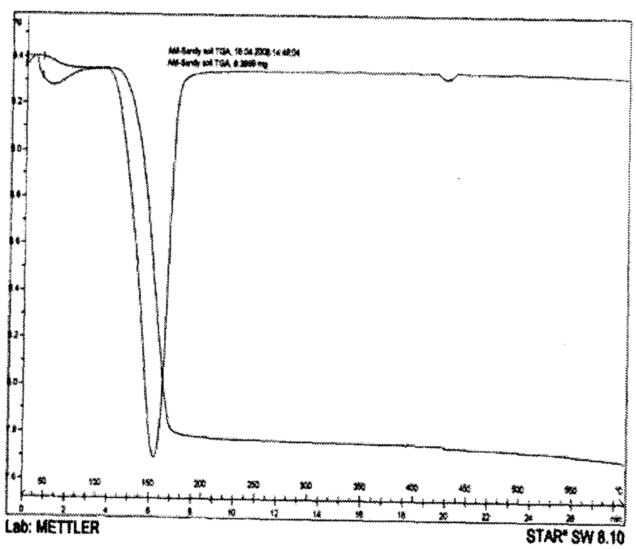

Fig. 8 TGA curve of arid soil.

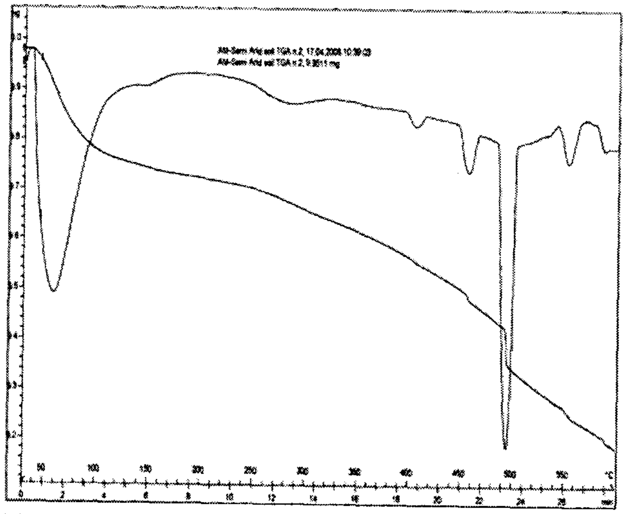

Fig. 9 TGA curve of semiarid soil.

3.7 X-Ray Analysis

XRD analysis showed that a crystalline peak appear at 22.47° for Cellulose Alfa-Alfa but it's amorphous for casting polyacrylamide (Figs. 10 and 11).

3.8 Scanning Electron Micrographs (SEM)

The morphology of soil particles at different dimensions was shown in Fig. 12 for semi arid soil and Fig. 13 for arid soil; also the esparto fibers were investigated by SEM as shown in Fig. 14.

The treatment of arid soil and semi arid soil with a mixture blend of esparto fibers-polyacrylamide was illustrated in Figs. 15 and 16 which illustrate the dispersion of the cellulose fibres of esparto grass and polyacrylamid as a blend at soils surface to allow water and humidity retention.

3.9 Evaporation and Infiltration

3.9.1 Evaporation

Results from Fig. 17 and Fig. 18 indicated that the two soils had different hydro physical properties, such that clay soil (S_2) was higher in water retention than sandy soil (S_1) (Fig. 19).

The study revealed that polymer-halfa cellulose fibre blend reduced evaporation significantly on both soils.

For all mulching rates of both soils, it has been found that the soil water profile distribution was significantly

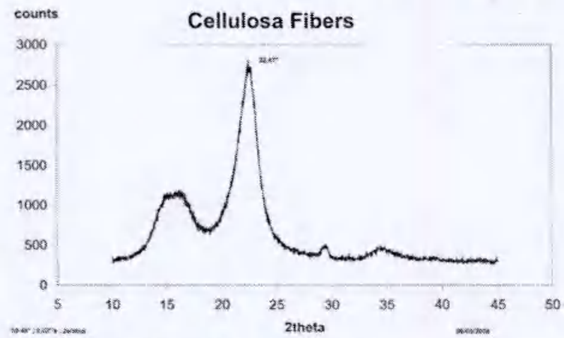

Fig. 10 X-ray diffractograms of Cellulose.

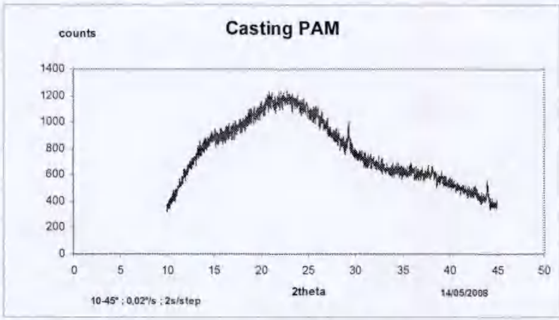

Fig. 11 X-Ray diffractograms of PAM.

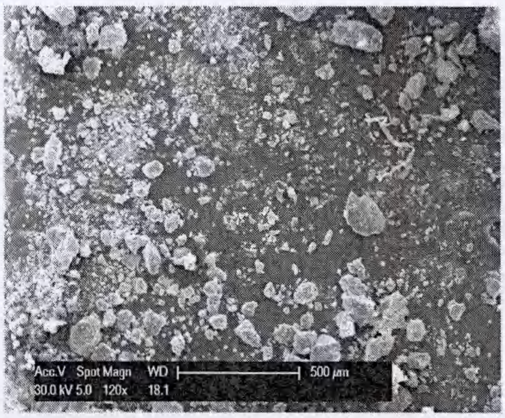

Fig. 12 Scanning electron micrographs of semi arid soil.

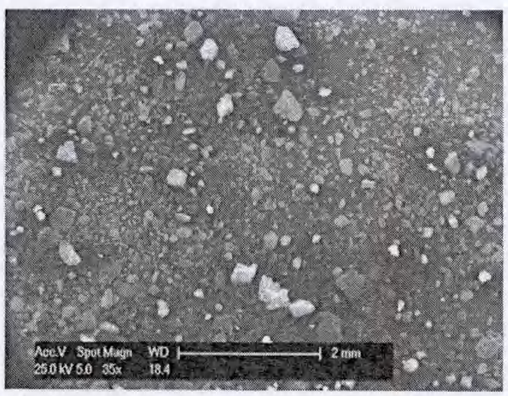

Fig. 13 Scanning electron micrographs of arid soil.

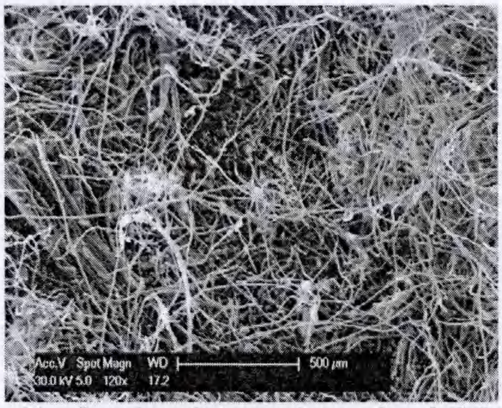

Fig. 14 Scanning electron micrographs of Cellulose Alfa-Alfa.

Fig. 15 Scanning electron micrographs of arid soil treated with PAM-Cellulose.

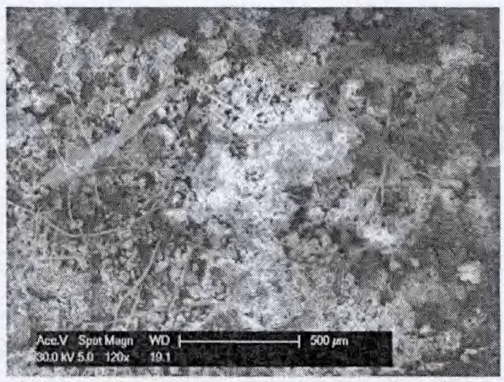

Fig. 16 Scanning electron micrographs of semi arid soil treated with PAM-Cellulose.

higher with mulched soil columns compared with the control for both soils. However, there were no significant differences between polymer-halfa cellulose fibre blend mulching with 2 or 5 cm depth, these results were reflected on the soil water storage, where mulched soil columns were higher than that of the control.

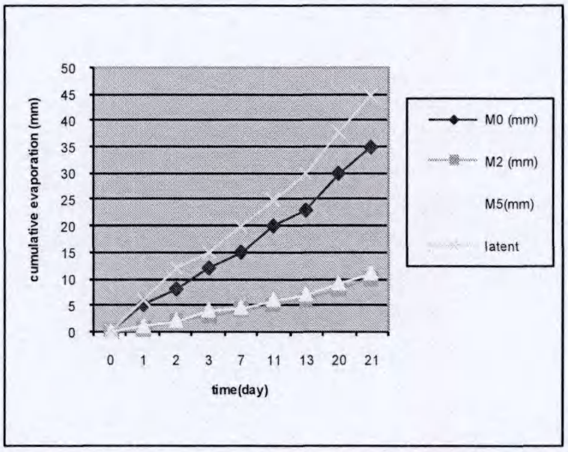

Fig. 17 Blend mulching of Polyacrylamide-Cellulose fibre effect at daily clay soil (S_2) cumulative evaporation.

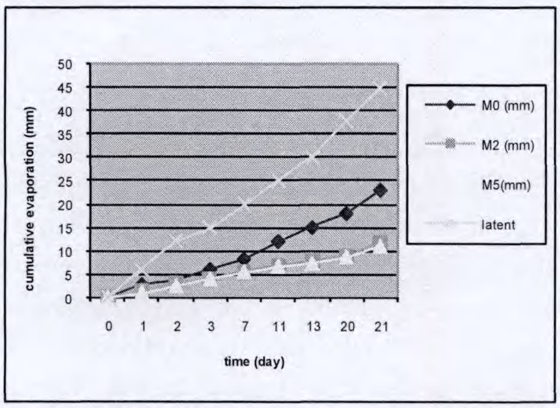

Fig. 18 Blend mulching of Polyacrylamide-Cellulose fibre effect at daily sandy soil (S_1) cumulative evaporation.

: Mulching at 0 cm;
: Mulching at 2 cm;
: Mulching at 5 cm;
: Latent evaporation (evaporation of free water).

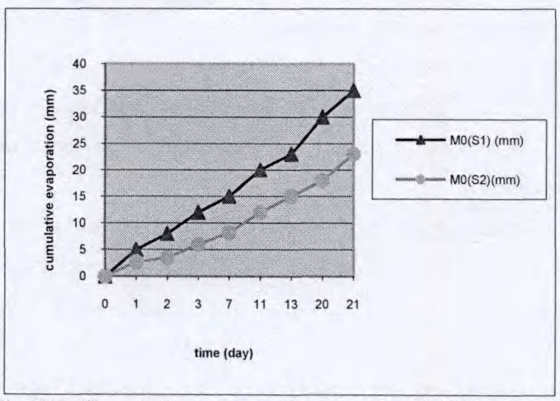

Fig. 19 Cumulative evaporation of arid soil (S_1) and semi arid soil (S_2).

: Mulching of semiarid soil at 0 cm;
: Mulching of arid soil at 0 cm.

3.9.2 Infiltration

From Fig. 20 and Fig. 21, we can remark that the cumulative infiltration of water in arid soil S_1 is more important than in semi arid soil (S_2).

This difference is due to soil type structure because it's more porous in sandy soil than in clay soil, for that the water penetrate rapidly in sandy soil than clay soils. The cumulative infiltration depth affected by time when arid and semi arid soil were amended with Polyacrylamide-Celluloses blend is shown in Fig. 21 and Fig. 22, and there was an increase in cumulative infiltration with increase in time for both soils.

However, a remarkable reduction in cumulative infiltration between the control and the treated soils was observed with the addition of polyacrylamide-cellulose fibre blend.

This decrease in cumulative infiltration in soil treated with polyacrylamide-cellulose blend values could be attributed mainly to the blend which improved the texture and structure of these soils, promoted soil

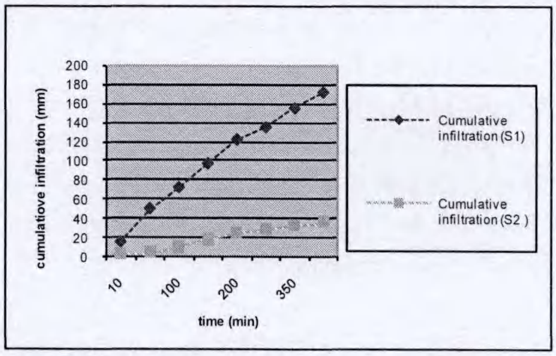

Fig. 20 Difference cumulative infiltration between sandy soil (S_1) and clay soil (S_2).

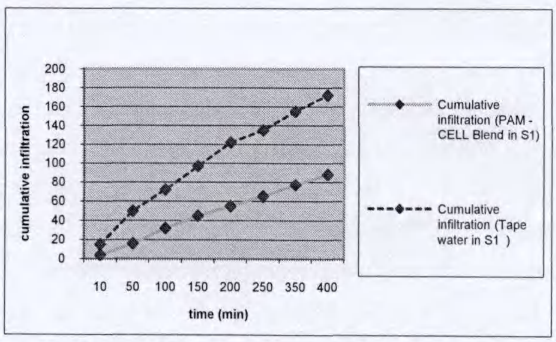

Fig. 21 Cumulative infiltration of sandy soil (S_1) and sandy soil treated with PAM-Cellulose fibre blend.

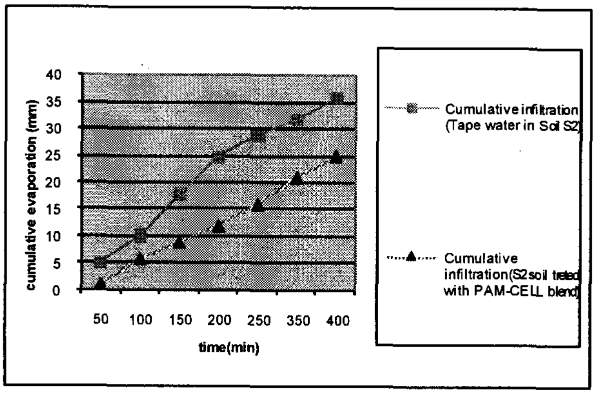

Fig. 22 Cumulative infiltration of clay soil (S_2) and clay soil treated with PAM-Cellulose fiber Blend.

aggregates swelling, and increased water retention, consequently decreasing cumulative infiltration.

3.10 Protocol of Blend Preparation

For cellulose fiber-polyacrylamide blend preparation, we can suggest this protocol as shown in Fig. 23.

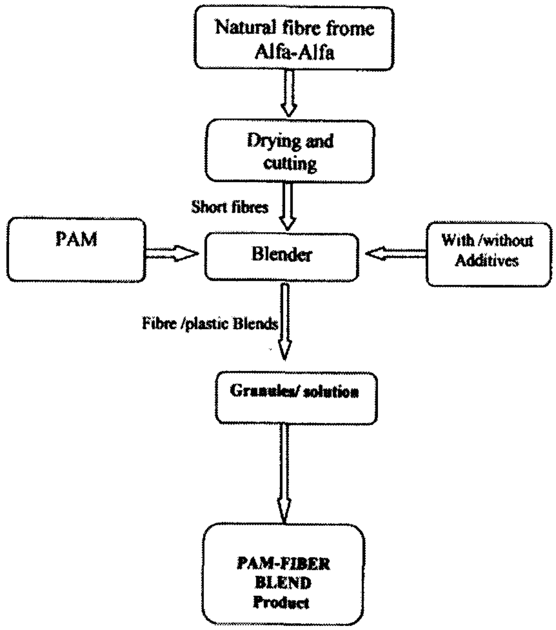

Fig. 23 Protocol suggested for PAM-fiber cellulose blend.

4. Conclusions

These synthetic and natural polymers show possible applicability as blend and composite on agriculture especially at desert regions to improve physical properties of soils by binding particles together and retain water. Among prepared composites and blend polymers, the Polyacrylamide-Cellulose blend showed positive results concerning water retention and improving soil proprieties.

Polyacrylamide-Cellulose mixture at arid and semiarid soils can increase the retention of water against evaporation losses; the water retained by polymers can be used by the plants and this addition enhanced plant growth and improved soil proprieties to assist plant growth in arid regions. Water conservation requires porous soils which are best accomplished with polyacrylamide soil moisture, can then be maintained longer by decreasing evaporative loss. Well structured soils have less evaporative loss because of the top soil surface treated with polymers blend acts as mulch.

Polyacrylamide-Cellulose Blend was used at 0, 2, and 5 cm depth of soil surface in soil columns. Tape water was added on the basis of required water to saturate soil. Results indicated that the two soils had different hydro physical properties, such that clay soil was higher in water retention. The study revealed that Polyacrylamide-Cellulose blend mulching reduced evaporation significantly on both soils. It has been found that the soil water profile distribution was significantly higher with mulched soil columns compared with the control for both soils However, there were no significant difference between Polyacrylamide-Cellulose mulching with 2 or 5cm depth. These results were reflected on the soil water storage, where mulched soil columns were higher than that of the control. The use of biopolymers would be highly recommended to improve the physical and chemical characteristics of the arid and semiarid soils in order to achieve a sustainable agricultural production.

The use of Polyacrylamide-Cellulose blend appears to promise for reducing the labour cost of irrigation at arid and semi-arid soils, and offers safe and environmentally friendly inexpensive materials. And the use of polymers and biopolymers would be highly recommended to improve the physical and chemical characteristics of the arid and semiarid soils in order to achieve a sustainable agricultural production.

The chemical fertility of these soils is ensured with Polyacrylamide-Cellulose blend soil application. It may be improved by increasing soil nitrogen contents from the Polyacrylamide application. Polysaccharides rate in soil is increased by using cellulose fibre, which are naturally few abundant and very important for soil chemistry in these soils.

We can conclude the importance of Polyacrylamide-Cellulose blend to alleviate poor physical properties and retain water in these arid regions to sustain plant growth.

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