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Studies on the Germination and Growth of Cotton and Groundnut Seeds Irrigated by Distillery Spentwash

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Abstract

Germination of Cotton and Ground nut seeds was made by irrigated with distillery spentwash of different concentration. The spentwash i.e. primary treated spentwash [PTSW] 1:1, 1:2 and 1:3 spentwash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and physical & chemical characteristics. Experimental soil was tested for its chemical physical parameters. Cotton and Ground nut seeds were sowed in the prepared land and irrigated with raw water (RW), 1:1, 1:2 and 1:3 (SW: RW) spentwash. The nature of germination of seeds was studied. It was found that, the germination was good (100%) in 1:3 SW irrigation, while very poor in 1:1 SW (25%), moderate in 1:2 SW (80%) and 95% in RW irrigations.

Key Words: Distillery spentwash, Cotton seed, Groundnut seed, Germination, Irrigation

Introduction

Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus *Gossypium*. The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, India, and Pakistan. The fiber most often is spun into yarn or thread and used to make a soft, breathable textile, which is the most widely used natural-fiber cloth in clothing today.

According to the Foods and Nutrition Encyclopedia, the earliest cultivation of cotton in the Americas occurred in Mexico, some 8,000 years ago. The indigenous species was *Gossypium hirsutum*, which is today the most widely planted species of cotton in the world, constituting about 89.9% of production worldwide. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa.

Cotton was first cultivated in the Old World 7,000 years ago (5th–4th millennia BC), by the inhabitants of the Indus Valley Civilization, which covered a huge swath of the northwestern part of the Indian subcontinent, comprising today parts of eastern Pakistan and northwestern India. The Indus cotton industry was well developed and some methods used in cotton spinning and fabrication continued to be used until the modern industrialization of India. Well before the Common Era, the use of cotton textiles had spread from India to the Mediterranean and beyond [1].

Cotton is used to make a number of textile products. These include terrycloth for highly absorbent bath towels and robes; denim for blue jeans; chambray, popularly used in the manufacture of blue work shirts (from which we get the term "blue-collar"); and corduroy, seersucker, and cotton twill. Socks, underwear, and most T-shirts are made from cotton. Bed sheets often are made from cotton. Cotton also is used to make yarn used in crochet and knitting. Fabric also can be made from recycled or recovered cotton that otherwise would be thrown away during the spinning, weaving, or cutting process. While many fabrics are made completely of cotton, some materials blend cotton with other fibers, including rayon and synthetic fibers such as polyester. It can either be used in knitted or woven fabrics, as it can be blended with elastine to make a stretchier thread for knitted fabrics, and apparel such as stretch jeans.

The peanut, or groundnut (*Arachis hypogaea*), is a species in the legume or "bean" family (Fabaceae). The cultivated peanut was probably first domesticated in the valleys of Peru[2]. It is an annual herbaceous plant growing 30 to 50 cm (0.98 to 1.6 ft) tall. The leaves are opposite, pinnate with four leaflets (two opposite pairs; no terminal leaflet), each leaflet 1 to 7 cm (⅜ to 2¾ in) long and 1 to 3 cm (⅜ to 1 inch) broad. The flowers are a typical peaflower in shape, 2 to 4 cm (¾ to 1½ in) across, yellow with reddish veining. After pollination, the fruit develops into a legume 3 to 7 cm (1.2 to 2.8 in) long, containing 1 to 4 seeds, which forces its way underground to mature. *Hypogaea* means "under the earth."

Peanuts are known by many other local names such as earthnuts, ground nuts, goober peas, monkey nuts, pygmy nuts and pig nuts [3]. Peanuts have many uses. They can be eaten as straight food, used in recipes, made into solvents and oils, used in make-up, medicines, textile materials, peanut butter, as well as many other uses. Popular confections made from peanuts include salted peanuts, peanut butter (sandwiches, peanut candy bars, peanut butter cookies, and cups), peanut brittle, and shelled nuts (plain/roasted). Peanuts, served by them, are one of the most popular nuts in the world. They are often eaten as snacks, served at cocktail parties and are sometimes added as a balanced and nutritional side dish with lunch. Salted peanuts are usually roasted in oil and packed in retail-size plastic bags or hermetically sealed cans. Dry roasted, salted peanuts are also marketed in significant

quantities. Peanuts are often a major ingredient in mixed nuts because of their inexpensiveness compared to Brazil nuts, cashews, walnuts, and so on. Although peanut butter has been a tradition on camping trips and the like because of its high protein count and the fact that it resists spoiling for long periods of time, the primary use of peanut butter is in the home, but large quantities are also used in the commercial manufacture of sandwiches, candy, and bakery products. Boiled peanuts are a preparation of raw, unshelled green peanuts boiled in brine and eaten as a snack in the United States. More recently, fried peanut recipes have emerged - allowing both shell and nut to be eaten. Peanuts are also used in a wide variety of other areas, such as cosmetics, nitroglycerin, plastics, dyes and paints.

Peanuts are used to help fight malnutrition. Plumpy Nut and Medika Mamba [4] are high protein, high energy and high nutrient peanut-based pastes that were developed to be used as a therapeutic food to aid in famine relief. Organizations like the World Health Organization, UNICEF, Project Peanut Butter and Doctors Without Borders have used these products to help save malnourished children in developing countries. Peanuts have a variety of industrial end uses. Paint, varnish, lubricating oil, leather dressings, furniture polish, insecticides, and nitroglycerin are made from peanut oil. Soap is made from saponified oil, and many cosmetics contain peanut oil and its derivatives. The protein portion of the oil is used in the manufacture of some textile fibers. Peanut shells are used in the manufacture of plastic, wallboard, abrasives, fuel, cellulose (used in rayon and paper) and mucilage (glue). Rudolf Diesel ran some of the first engines that bear his name on peanut oil and it is still seen as a potentially useful fuel.

Peanuts are rich in nutrients, providing over 30 essential nutrients and phytonutrients. Peanuts are a good source of niacin, folate, fiber, magnesium, vitamin E, manganese and phosphorus. They also are naturally free of trans-fats and sodium, and contain about 25% protein (a higher proportion than in any true nut).

Molasses (one of the important byproduct of sugar industry) is the main source for the production of Ethanol in distilleries by fermentation method. About 08 (eight) liters of waste water is generated for every liter of ethanol production in distilleries, known as raw spentwash(RSW) which is characterized by high biological oxygen demand (BOD:5000-8000 mg/L) and chemical oxygen demand (COD :25000-30000mg/L), undesirable color and foul odor [5]. Discharge of raw spentwash into open land or near by water bodies is dangerous, since it results in number of environmental, water and soil pollution including threat to plant and animal lives. The RSW is highly acidic and contains easily oxdisable organic matter with very high BOD and COD [6]. Also, spentwash contains high organic nitrogen and nutrients [7]. By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting spentwash is called primary treated spent wash(PTSW) and primary treated to RSW increases the nitrogen (N), phosphorous (P) and potassium(K) and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride(Cl^-), and sulphate(SO_4^{2-})[8]. The PTSW is rich in potassium (K), sulphur (S), Nitrogen(N), Phosphorous(P), as well as easily bio degradable organic matter and its application to soil has been reported to increase the yield of sugarcane[9], rice [10], wheat, rice yield [11], quality of groundnut [12] and physiological response of soybean [13]. Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility [14,15,16], seed germination and crop productivity [17]. The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil micro flora [18,19,14]. Twelve pre-sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield [20]. Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas [21]. Increased concentration of spentwash causes decreased seed germination, seedling growth and chlorophyll content in sunflowers (Helianthus annuus) and the spentwash could safely used for irrigation purpose at lower concentration [22,17]. The spentwash contained in excess of various forms of cations, anions, which are injurious to plant growth and these constituents should be reduced to beneficial level by diluting the spentwash, which can be used as substitute for chemical fertilizer [23], the spentwash could be used as a compliment to mineral fertilizer to sugarcane [24].The spent wash contained N, P, K, Ca, Mg and S and thus valued as a fertilizer when applied to soil through irrigation with water [25]. The application of diluted spentwash increased the up take of Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn) in Maize and wheat as compared to control and the highest total uptake of these were found at lower dilution levels than at higher dilution levels [26], mineralization of organic material as well as nutrients present in the spent wash were responsible for increased availability of plant nutrients. Diluted spentwash increase the up take of nutrients, height, growth and yield of leaves vegetables [27,28], nutrients of cabbage and mint leaf [29], nutrients of top vegetable, pulses, condiments, root vegetables and yields of condiments [30]. However no information is available on the studies of germination of Mustard and Castor oil seeds irrigated by distillery spentwash. Therefore, the present investigation was carried out to study the influence of different proportions of spentwash on the germination of Mustard and Castor seeds.

Materials and Methods

Field work was conducted at own land in Halebudanur village near Mandya, Karnataka. Before cultivation, a composite soil sample was collected from experimental site at 25.cm depth at different sites, mixed and dried under sunlight. The sample was analyzed by standard procedures (Table-1). The PTSW was used for irrigation with a dilution of 1:1, 1:2 and 1:3 ratios. The physical and chemical characteristics and amount of nitrogen(N) Potassium(K), Phosphorous(P) and sulphur (S) present in the PTSW, 1:1, 1:2 and 1:3 distillery spentwash were analyzed [31],using standard procedures (Table-2,3).

Table1. Physico-chemical properties of soil

Parameters	Values
Coarse sand [c]	9.85
Fine sand [c]	40.72
Slit [c]	25.77
Clay [c]	23.66
pH (1:2 soln)	8.41
Electrical Conductivity [a]	540
Organic Carbon [c]	1.77
Available Nitrogen [b]	402
Available Phosphorous [b]	202
Available Potassium [b]	113
Exchangable Calcium [b]	185
Exchangable Magnesium [b]	276
Exchangable Sodium [b]	115
Available Sulphur [b]	337
DTPA Iron [b]	202
DTPA Manganese [b]	210
DTPA Copper [b]	12
DTPA Zinc [b]	60

Units: a – µS, **b**-mg\L, **c**-%

Table 2: Chemical characteristics of distillery spent wash at different dilution

Chemical parameters	PTSW	1:1 PTSW	1:2 PTSW	1:3 PTSW
pH	7.57	7.63	7.65	7.66
Electrical	26400	17260	7620	5330
Total solids	47200	27230	21930	15625
Total dissolved solids [b]	37100	18000	12080	64520
Total suspended solids [b]	10240	5830	2820	1250
Settleable solids [b]	9880	4150	4700	3240
COD [b]	41250	19036	4700	2140
BOD [b]	16100	7718	4700	2430
Carbonate [b]	Nil	Nil	Nil	Nil
Bicarbonate [b]	12200	6500	3300	1250
Total Phosphorous [b]	40.5	22.44	17.03	10.80
Total potassium [b]	7500	4000	2700	1620
Calcium [b]	900	590	370	190
Magnesium [b]	1244.16	476.16	134.22	85
Sulphur [b]	70	30.2	17.8	8.4
Sodium [b]	520	300	280	140
Chlorides [b]	6204	3512	3404	2960
Iron [b]	7.5	4.7	3.5	2.1
Manganese [b]	980	495	288	160
Zinc [b]	1.5	0.94	0.63	0.56
Copper [b]	0.25	0.108	0.048	0.026
Cadmium [b]	0.005	0.003	0.002	0.001
Lead [b]	0.16	0.09	0.06	0.003
Chromium [b]	0.05	0.026	0.012	0.008
Nickel [b]	0.09	0.045	0.025	0.012
Ammonical Nitrogen [b]	750.8	352.36	283.76	178
Carbohydrates [c]	22.80	11.56	8.12	6.20

Units: a – µS, **b**-mg/L, **c**- **%, PTSW** – Primary treated spentwash

Table 3: Amount of N, P, K and S (Nutrients) in Spentwash

Chemical Parameters	PTSW	1:1PTSW	1:2 PTSW	1:3 PTSW
Ammonical Nitrogen[a]	750.8	352.36	283.76	160.5
Total Phosphorous[a]	40.5	22.44	17.03	11.2
Total Potassium[a]	7500	4000	2700	1800
Sulphur[a]	70	30.2	17.8	8.6

Unit: a- mg/L, **PTSW:** Primary treated spentwash

Table 4. Growth of plants at different irrigations (cm)

Name of the Plant	RW	1:1SW	1:2SW	1:3SW
	15th 22nd 29th (Day)	15th 22nd 29th (Day)	15th 22nd 29th (Day)	15th 22nd 29th (Day)
Cotton (Gossypium species)	1.2, 8.4, 7.1	1.4, 8.2, 8.7	1.7, 8.9, 10.1	2.0, 9.2, 12.1
Ground Nut (Arachis Hypogea)	4.1, 8.2, 9.0,	4.5, 8.0, 8.1	5.2, 9.4, 11.5	5.7, 10.9, 14.3

Oil seed plants selected for the present investigation were Mustard and Castor. The seeds were sowed and irrigated (by applying 5-10 mm^3/cm^2 depends upon the climatic condition) with raw water (RW), 1:1,1:2 and 1:3 SW at the dosage of twice a week and rest of the period with raw water depend upon the climatic condition. Trials were conducted for three times and average growth were recorded (Table-4).

Results

Characteristics of experimental soils such as pH, electrical conductivity, the amount of organic carbon, available nitrogen(N), phosphorous(p), Potassium(K), sulphur (S), exchangeable calcium(Ca), Magnesium(Mg), Sodium(Na), DTPA iron(Fe), manganese(Mn), copper(Cu) and zinc (Zn) were analyzed and tabulated (Table-1). It was found that the soil composition is fit for the cultivation of plants, because it fulfils all the requirements for the growth of plants. Chemical composition of PTSW, 1:1,1:2 and1:3 SW such as pH, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids(TSS), settelable solids (SS), chemical oxygen demand(COD), biological oxygen demand(BOD), carbonates, discarbonates, total phosphorous(P), total potassium(K), ammonical nitrogen (N), calcium(Ca) magnesium(Mg), sulphur(S), Sodium(Na), chlorides(Cl), iron(Fe), Manganese(Mn), zinc(Zn), copper(Cu), cadmium(Cd), lead(Pb), chromium(Cr) and nickel (Ni), were analyzed and tabulated[32,33] (Table-2). Amount of N, P, K and S contents are presented in Table-3

In both cases, the germination was 100% in 1:3 SW, 25% in 1:1 SW, 80% in 1:2 SW and 95% in RW irrigations. Growth rate was very poor in 1:1 SW irrigation compare with RW, 1:2 SW and 1:3 SW irrigations. Maximum growth rate was observed in 1:3 SW compare to RW, 1:1 SW and 1:2 SW irrigations.

Discussion

It was found that the germination of was good (100%) in 1:3 SW irrigation, while very poor in 1:1SW (25%), moderate in 1:2 SW (80%) and 95% in RW irrigations. In 1:1 dilution, the germination was very poor (25%), this could be due to the high concentration of spentwash makes mask on the upper layer of soil, through which the seeds may not sprout within the stipulated time and spoil. But in 1:3 dilution 100% germination was observed, this could be due to the sufficient quantity of moisture and plant nutrients available to seeds.

Conclusion

It concludes that, the spentwash can be conveniently used with proper dilution for irrigation purpose without affecting the nature of soil, environmental pollution and without using any external fertilizers (either Organic or Inorganic).

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