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RESEARCH ARTICLE

IRRIGATIONAL IMPACT OF DISTILLERY SPENT WASH ON THE GERMINATION AND GROWTH OF SESAME SEEDS (SESAMU INDICUM)

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ABSTRACT

Germination of Sesame (Sesamu indicum) seeds was made by irrigated with distillery spentwash of different concentration. Primary treated spentwash [PTSW], dilution with water in the ratio 1:1, 1:2 and 1:3 were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and physical & chemical characteristics. Experimental soil was tested for its physic-chemical parameters. Sesame 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 and growth of seeds was studied. It was found that, the germination as well as growth 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.

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INTRODUCTION

Mustard seeds are the small round seeds of various mustard plants. The seeds are typically about 1 or 2 mm in diameter. Mustard seeds may be colored from yellowish white to black. They are important spices in many regional cuisines. The seeds can come from three different plants: black mustard (Brassica nigra), brown Indian mustard (B. juncea), and white mustard (B. hirta/Sinapis alba). Earliest reference to mustard in India is from the story of Buddha in 5th century BCE. ("The Mustard Seed" Retrieved, 2010**).** The French have used mustard seeds as a spice since 800 AD, and it was among the spices taken by the Spanish on explorations throughout the fifteenth century. Mustard oil is very good for body massage during extreme winters, as it keeps the body warm and moist. Mustard seeds generally take three to ten days to germinate if placed under the proper conditions, which include a cold atmosphere and relatively moist soil. Major producers of mustard seeds include Canada (90%), Hungary, Great Britain, India, Pakistan and the United States. Brown and black mustard seeds return higher yields than their yellow counterparts. In Pakistan after cotton, rapeseed-mustard is the second most important source of oil in Pakistan. It is cultivated over an area of 307,000 hectares with annual production of 233,000 tones and contributes about 17% to the domestic production of edible oil. Mustard seed is a rich source of oil and protein. The seed has oil as high as 46-48 %, Whole seed meal has 43.6 % protein. Castor oil penetrates deep into the skin due to its molecular mass, which is low enough to penetrate deepinto the stratum corneum. Castor isostearate succinate is a polymeric mixture of esters with isostearic acid and succinic acid used for skin conditioning, such as in shampoo, lipstick and lip balm. Ricinoleic is the main component of castor oil, and it exerts anti-inflammatory effects. One study has found castor oil decreased pain more than ultrasound gel or Vaseline during extracorporeal shockwave application (Maier *et al.,* 1999). The use of cold pressed castor oil (CPCO) in folk medicine predates government medical regulations. The oil is also used as a rub or pack for various ailments, including abdominal complaints, headaches, muscle pains, inflammatory conditions, skin eruptions, lesions, and sinusitis. Castor oil has also been noted for its acne-healing abilities. In Ayurvedic medicine used to enhance memory (Dua *et al.,* 2009).

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Castor oil has numerous applications in transportation, cosmetics and pharmaceutical, and manufacturing industries, for example: brake fluids caulks ("Castor oil as a component of brake fluid" 2007), dyes, electrical liquid dielectrics, humectants, Nylon 11 plastics, hydraulic fluids, inks, lacquers, leather treatments, lubricating greases, machining oils, paints, pigments, polyurethane adhesive refrigeration (Azambuja, Maximiliano dos Anjos; Dias, Antonio Alves." 2006), lubricants, rubbers, sealants, textile, adhesives, washing powders, and waxes. Since it has a relatively high dielectric constant (4.7), highly refined and dried castor oil is sometimes used as a dielectric fluid within high performance high voltage capacitors. Castor oil is the preferred lubricant for bicycle pumps, most likely because it does not dissolve natural rubber seals (Older, Jules, Backroad and offroad biking,2000), Castor oil was the preferred lubricant for rotary engines, such as the Gnome engine after that engine's widespread adoption for aviation in Europe in 1909. It was used almost universally by the rotary engined allied aircraft in World War I. Cultivation of castor plants for the production of biodiesel started in 2008 in the Waletia and Goma Gofa regions of Ethiopia. The initiative is run by energy company Global Energy Ethiopia, who are also conducting a research and development programme to create new varieties of castor with better yields. As a means of punishment, the force-feeding with castor oil still lives on in animated cartoons such as Tom and Jerry.

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 (Joshi *et al.,* 1994), Discharge of raw spent wash into open land or nearby 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 (Patil, *et al.,*1987), Also, spentwash contains high organic nitrogen and nutrients (Ramadurai *et al.,* 1994), By installing biomet henation plant in distilleries, reduces the oxygen demand of RSW, the resulting spent wash 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-}) (Mohamed Haroon, *et al.,*2004), 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 (Zalawadia *et al.,*1997), rice (Devarajan, *et al.,*1995) wheat, rice yield (Pathak, *et al.,* 1998), quality of groundnut and physiological response of soybean (Ramana *et al.,* 2000), Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility seed germination and crop productivity (Ramana, *et al.,* 2001). The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil micro flora (Devarajan, *et al.,*1994), (Kaushi *et al*., 2005), (Kuntal *et al.,* 2004) Twelve pre-sowing irrigate (Kaushi *et al.,*2005), (Revekar *et al.,* 2000), (Ramana *et al.,*2000), ions with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield (Singh *et al.,* 1998), Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas. (Rani *et al*., 1990), 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 (Rajendran, 1990), (Ramana, *et al.,* 2001). 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 (Sahai *et al.,*1993), the spentwash could be used as a compliment to mineral fertilizer to sugarcane (Chare, 1985), 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 (Samuel, 1996). 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 (Pujar, 1995), 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 vegetable (Basavaraju *et al.,* 2007), (Basavaraju, *et al.,* 2008). Nutrients of cabbage and mint leaf (Chandraju *et al.,* 2008), nutrients of top vegetable (Basavaraju, *et al.,* 2008), pulses, condiments, root vegetables (Chandraju, *et al.,* 2008) yields of condiments (Chidankumar *et al.,* 2009). 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 (Lindsay, *et al.,*1978) using standard procedures (Table-2 and 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 AND DISCUSSION

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 fulfills 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, dicarbonates, 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 (Manivasakam, 1987) (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.

Table 1. Physico-chemical properties of soil

Parameters	Values
Coarse sand [c]	9.75
Fine sand [c]	40.60
Slit [c]	25.60
Clay [c]	23.56
pH (1:2 soln)	8.31
Electrical Conductivity [a]	540
Organic Carbon [c]	1.67
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	7.47	7.52	7.54	7.55
Electrical conductivity	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]	40.4	22.34	17.02	10.60
Total potassium [b]	7500	4000	2700	1620
Calcium [b]	900	590	370	190
Magnesium [b]	1244.14	476.14	134.20	85
Sulphur [b]	70	30.0	17.6	8.2
Sodium [b]	520	300	280	140
Chlorides [b]	6204	3512	3404	2960
Iron [b]	7.4	4.6	3.4	2.0
Manganese [b]	980	495	288	160
Zinc [b]	1.4	0.92	0.60	0.50
Copper [b]	0.26	0.103	0.040	0.023
Cadmium [b]	0.005	0.004	0.003	0.002
Lead [b]	0.14	0.07	0.05	0.003
Chromium [b]	0.04	0.023	0.012	0.006
Nickel [b]	0.07	0.043	0.022	0.010
Ammonical Nitrogen [b]	750.6	352.30	283.72	178
Carbohydrates [c]	22.70	11.46	8.10	6.10

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 15th 22nd 29th (Day)	1:1SW 15th 22nd 29th (Day)	1:2SW 15th 22nd 29th (Day)	1:3SW 15th 22nd 29th (Day)
Castor *(Bicinus Cummunis)*	5.9, 10.3, 11.3	6.3, 10.1, 10.5	7.0, 11.4, 21.5	7.4, 16.1, 24.9
Mustard *(Brassica Nigra)*	7.2, 17.2, 21.6,	7.4, 15.4, 20.3	7.8, 16.1, 22.6	8.1, 17.2, 23.9

Conclusion

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.

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