Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V13.I2.00001

Received: 04-10-2022 Accepted: 18-12-2022 Publication: 31-01-2023

Indian J.Sci.Res. 13 (2): 01-05, 2023 Original Research Article

EFFECT OF DIFFERENT DISTILLERY EFFLUENTS ON EARLY GROWTH OF MUSTARD

RENU CHOUDHARY[a1] AND ASHISH TEJASVI[b]

[a]Department of Botany, Janta Vedic College, Baraut, Baghpat, U.P., India
[b]Department of Botany, Agra College, Agra, U.P., India

ABSTRACT

The present study was conducted to observe the impact of different concentrations (0.5, 1.0, 2.0, 5.0, 10, 25, 35, 45 and 55%) of different distillery effluents i.e. raw spent wash (RSW), biomethanated spent wash (BSW) and lagoon sludge (LS) which were collected from Shamli distillery and chemical works, Shamli on Mustard (*Brassica campestris*) cv. PAC-401 and 45J19. Distillery effluents (RSW, BSW and LS) considerably affected all the growth parameters in treated plants. Growth parameters improve up to 5% concentrations of RSW and up to 10% concentrations of BSW and LS, while above these concentrations, growth gets reduced significantly. Higher concentrations (i.e. >5% of RSW and >10% of BSW and LS) of distillery effluents proved detrimental to test crop varieties.

KEYWORDS: Biomethanated Spent Wash, Distillery Effluent, Germination, Lagoon Sludge, Raw Spent Wash

Mustard (*Brassica campestris* L.; Family-Brassicaceae) var. sarson (yellow sarson) is one of the most common oil yielding crops. Diverse nature of agro-based industrial effluents from various industries is disposed of into soil and water bodies causing major ecological challenges for mankind. Disposal of industrial effluents into fresh water bodies contaminates water. These effluents not only increase the nutrient level, but also exceed tolerance limits and cause toxicity. A large network of distilleries i.e. more than 300 have been established in India, which has been recognized as one of the most polluting agro-based industries generating huge quantities of distillery effluent. This distillery effluent is carrying a heavy load of heavy metals such as Pb, Zn, Cr, Ni and Cd along with a mixture of organic and inorganic nutrients (Pandey *et* al., 2008; Khan *et* al., 2019 and Khalkar, 2021). The heavy metals in distillery effluent may show biomagnification through food chains and their concentration become toxic in edible parts of crop plants, which are irrigated with distillery effluent by local farmers. Effluent treatment plants (ETP) have been setup with most of the distilleries. In ETP, raw distillery effluent (RSW) is carried to the biomethanation plant, where it is treated anaerobically with the help of methanogens, thus called biomethanated spent wash (BSW). This BSW is treated aerobically by aerated lagoons or by activated sludge process so that the final effluent is called lagoon sludge (LS). Aim of the present work was to study the effects of these distillery effluents (RSW, BSW and LS) on germination rate and growth of mustard varieties.

MATERIALS AND METHODS

Two cultivars of mustard (PAC-401, 45J19) were used as test crops for present study. Three different types of distillery effluents (RSW, BSW and LS) were collected from Shamli distillery and chemical works, Shamli and diluted with tap water to get 0.5%, 1.0%, 2.0%, 5%, 10%, 25%, 35%, 45%, and 55% concentrations. The tap water was used as control. The petri dishes and experimental plots were irrigated with different concentrations of effluent (RSW, BSW and LS) on alternate days. Seed germination percentage and the rate of germination index of seedlings were recorded at 8 DAS. Different growth parameters were observed at 25 DAS. Growth parameters recorded during the study were root, shoot length, biomass production and net primary productivity (NPP). Proper agronomical practices were used during the investigation.

RESULTS AND DISCUSSION

A slight increase in germination percentage was recorded up to 5% concentration of RSW and 10% concentration of BSW and LS. 100% seed germination was recorded at higher concentrations of RSW, BSW and LS in both test cultivars. Reduction in seed germination percentage was 42.42, 37.37 and 34.34% under 55% concentration of RSW, BSW and LS respectively in cv. PAC-401 and 37.00, 33.00 and 30.00% reduction in cv. 45J19 respectively (Table 1). The rate of germination index increased up to 10.35% in 5% RSW concentration and 15.26 and 12.80% in 10% BSW and LS concentration treatments respectively in cv. PAC-401.

[1]Corresponding author

However, these values were 6.31, 12.28 and 9.55% in cv. 45J19. The reduction percentage was 20.00, 16.84 and 15.61% under 55% of RSW, BSW and LS concentration in cv. PAC-401, similar pattern of reduction was exhibited by cv. 45J19.

Table 1: Effect of different concentrations of distillery effluents on seed germination percentage and rate of germination index at 8 DAS seedlings of mustard cultivars

Cultivar	Parameters	Treatments									
		RSW concentration (%)									
		Control	0.5	1.0	2.0	5.0	10	25	35	45	55
PAC-401	Seed germination percentage	99	99	100	100	100	95	84	74	66	57
	Rate of germination index	570	576	591	608	629	541	520	503	478	456
45J19	Seed germination percentage	100	100	100	100	100	97	87	79	70	63
	Rate of germination index	586	590	596	612	623	557	529	517	493	475
		BSW concentration (%)									
PAC-401	Seed germination percentage	99	100	100	100	100	100	86	79	70	62
	Rate of germination index	570	581	597	615	636	657	542	520	503	474
45J19	Seed germination percentage	100	100	100	100	100	100	90	83	74	67
	Rate of germination index	586	594	605	620	640	658	557	541	523	495
		LS concentration (%)									
PAC-401	Seed germination percentage	99	99	99	100	100	100	91	83	72	65
	Rate of germination index	570	573	588	605	626	643	556	529	511	481
45J19	Seed germination percentage	100	100	100	100	100	100	91	85	77	70
	Rate of germination index	586	588	593	608	620	642	568	554	536	509

The effects of different concentrations of distillery effluents (RSW, BSW and LS) on *Brassica campestris* cultivars were studied for various growth parameters at 25 DAS and the recorded data presented in Table 2. The root length was increased up to 22.00% at 5% of RSW and 25.40 and 23.78% at 10% concentrations of BSW and LS treatments. A reduction of 32.03, 26.05 and 24.43 % in RSW, BSW and LS respectively was observed at 55% concentration in cv. PAC-401. The similar pattern was also followed by 45J19 cultivar. The shoot length of both cultivars was found to be significantly increased at 5% of RSW and 10% of BSW and LS treatments. In cv. PAC-401, shoot length increased up to 19.93, 25.20 and 22.67% respectively, while in cv. 45J19 these values were 21.80, 26.69 and 23.30% respectively. At 55% concentration of RSW, BSW and LS, shoot length reduced by 29.04, 25.70 and 23.78% in cv. PAC-401 and in cv. 45J19 these reductions were 27.16, 24.62 and 22.36% respectively. In 25 days old plants of cv. PAC-401, phytomass increased up to 22.55% at 5% of RSW and 29.32 and 24.06% at 10% of BSW and LS concentration respectively. While a reduction of 25.93, 22.93 and 21.05% in 55% of RSW, BSW and LS treatments was recorded respectively. In cv. 45J19, up to 5% of RSW treatment, phytomass accumulation increased by 25.43% and up to 10% of BSW and LS phytomass increased by 30.66 and 26.13% respectively. Loss in total dry weight or phytomass accumulation eventually leads to decrease in net primary productivity (NPP) of treated plants. These results are in conformity with those of Adikane *et al*., 2006; Kalaiselvi *et al* ., 2009; Rath et *al*., 2010; Bharti, 2014; Kumar, 2014; Goli and Sahu, 2014; Chandraju *et al*., 2015; Qureshi *et al*., 2015; Reddy *et al*., 2015; Jacob *et al*., 2016; Sharma and Malaviya, 2016; Mishra and Gupta, 2017; Snehlata *et al*., 2018; Kapil and Mathur, 2020;Umair *et al*., 2021; Khalkar, 2021and Bartkowiak *et al*., 2022.

Table 2: Effect of different concentrations of distillery effluents on different growth parameters at 25 DAS plants of of mustard cultivars

Cultivar	Parameters	Treatments									
		RSW concentration (%)									
		Control	0.5	1.0	2.0	5.0	10	25	35	45	55
PAC-401	Root length (cm)	6.18 ±0.84	6.36 ±0.81†	6.78 ±0.77†	7.11 ±0.72*	7.54 ±0.79**	5.79 ±0.82†	5.34 ±0.74*	5.01 ±0.67*	4.58 ±0.65**	4.20 ±0.69**
	Shoot length (cm)	9.88 ±0.62	10.27 ±0.83†	10.76 ±0.88†	11.29 ±0.89*	11.85 ±0.82**	9.19 ±0.60†	8.18 ±0.56*	7.76 ±0.59**	7.38 ±0.73**	7.01 ±0.76**
	Biomass production (g)	2.66 ±0.46	2.77 ±0.52†	2.90 ±0.67†	3.09 ±0.59*	3.26 ±0.61**	2.51 ±0.45†	2.36 ±0.42*	2.23 ±0.38*	2.12 ±0.36**	1.97 ±0.31**
	NPP (g/plant/ day)	0.106	0.110	0.116	0.123	0.130	0.100	0.094	0.089	0.084	0.078
		BSW concentration (%)									
	Root length (cm)	6.18 ±0.84	6.42 ±0.76†	6.88 ±0.85†	7.22 ±0.73*	7.64 ±0.88**	7.75 ±0.81**	5.67 ±0.75†	5.24 ±0.71*	4.82 ±0.67**	4.57 ±0.65**
	Shoot length (cm)	9.88 ±0.62	10.50 ±0.68†	10.98 ±0.60†	11.54 ±0.67*	12.04 ±0.70**	12.17 ±0.63**	8.62 ±0.59†	8.18 ±0.55*	7.76 ±0.63**	7.34 ±0.54**
	Biomass production (g)	2.66 ±0.46	2.79 ±0.48†	3.03 ±0.44*	3.19 ±0.49**	3.35 ±0.52**	3.44 ±0.43**	2.43 ±0.39†	2.30 ±0.41*	2.18 ±0.37**	2.05 ±0.33**
	NPP (g/plant/ day)	0.106	0.111	0.121	0.127	0.134	0.137	0.097	0.092	0.87	0.082
		LS concentration (%)									
	Root length (cm)	6.18 ±0.84	6.30 ±0.81†	6.68 ±0.87†	7.01 ±0.76*	7.43 ±0.89**	7.65 ±0.82**	5.80 ±0.78†	5.37 ±0.83*	4.94 ±0.72**	4.67 ±0.76**
	Shoot length (cm)	9.88 ±0.62	10.23 ±0.65†	10.72 ±0.60†	11.22 ±0.58*	11.69 ±0.64**	12.12 ±0.69**	8.89 ±0.71†	8.30 ±0.66*	7.96 ±0.60**	7.53 ±0.59**
	Biomass production (g)	2.66 ±0.46	2.73 ±0.43†	2.85 ±0.49†	3.01 ±0.52*	3.19 ±0.56**	3.30 ±0.58**	2.51 ±0.44†	2.39 ±0.41*	2.27 ±0.37*	2.10 ±0.35**
	NPP (g/plant/ day)	0.106	0.109	0.114	0.120	0.127	0.132	0.100	0.095	0.090	0.084
45J19		RSW concentration (%)									
	Root length (cm)	6.89 ±0.76	7.24 ±0.73†	7.78 ±0.80*	8.23 ±0.83*	8.60 ±0.92**	6.56 ±0.72†	5.93 ±0.68*	5.48 ±0.63*	5.20 ±0.65**	4.93 ±0.61**
	Shoot length (cm)	10.64 ±1.28	11.07 ±1.17†	11.68 ±1.24†	12.27 ±1.31*	12.96 ±1.44**	10.08 ±1.41†	9.36 ±1.07*	8.98 ±0.93**	8.34 ±0.88**	7.75 ±0.82**
	Biomass production (g)	2.87 ±0.52	2.99 ±0.56†	3.20 ±0.59*	3.42 ±0.62*	3.60 ±0.65**	2.68 ±0.61†	2.53 ±0.54*	2.39 ±0.49**	2.27 ±0.47**	2.14 ±0.43**
	NPP (g/plant/ day)	0.114	0.119	0.128	0.136	0.144	0.107	0.101	0.095	0.090	0.085
		BSW concentration (%)									
	Root length (cm)	6.89 ±0.76	7.33 ±0.78†	7.88 ±0.82*	8.34 ±0.74*	8.71 ±0.87**	8.80 ±0.84**	6.16 ±0.73†	5.71 ±0.70*	5.42 ±0.64**	5.16 ±0.67**
	Shoot length (cm)	10.64 ±1.28	11.37 ±1.31†	11.98 ±1.36*	12.59 ±1.27*	13.06 ±1.34**	13.48 ±1.29**	9.54 ±1.13†	9.18 ±1.04*	8.57 ±0.93**	8.02 ±0.89**
	Biomass production (g)	2.87 ±0.52	3.03 ±0.54†	3.25 ±0.59*	3.47 ±0.62**	3.65 ±0.66**	3.75 ±0.64**	2.64 ±0.55†	2.51 ±0.47*	2.38 ±0.42**	2.24 ±0.48**
	NPP (g/plant/ day)	0.114	0.121	0.130	0.138	0.146	0.150	0.105	0.100	0.095	0.089
		LS concentration (%)									
	Root length (cm)	6.89 ±0.76	7.20 ±0.72†	7.67 ±0.80*	8.11 ±0.83*	8.45 ±0.87**	8.62 ±0.84**	6.30 ±0.74†	5.85 ±0.71*	5.56 ±0.67**	5.29 ±0.64**
	Shoot length (cm)	10.64 ±1.28	11.02 ±1.33†	11.63 ±1.30†	12.19 ±1.38*	12.63 ±1.22**	13.12 ±1.35**	9.60 ±1.22†	9.35 ±1.12*	8.80 ±0.98**	8.26 ±0.88**
	Biomass production (g)	2.87 ±0.52	2.94 ±0.56†	3.16 ±0.63†	3.37 ±0.67*	3.54 ±0.71**	3.62 ±0.69**	2.72 ±0.54†	2.59 ±0.48*	2.46 ±0.43**	2.33 ±0.45**
	NPP (g/plant/ day)	0.114	0.117	0.126	0.134	0.141	0.144	0.108	0.103	0.098	0.093

Values are in mean ± standard deviation

Significance of difference from control; P* < 0.05; P < 0.01 and † non-significant**

CONCLUSION

All the treated plants under study were found sensitive to distillery effluents and their responses vary with effluent concentrations. Higher concentrations (>5% of RSW and >10% of BSW and LS) of distillery effluents proved detrimental to the test crop cultivars. Lower concentrations of these effluents showed beneficial effects on mustard growth. Lower concentrations promote the all early growth parameters of treated plants, thus distillery effluent irrigation can be used as liquid manure after proper dilution and treatments. Although, a long term investigations must be carried out to access the heavy metals impact on soil productivity and crop productivity.

REFERENCES

Adikane H.V., Dange M.N. and Selvakumari K., 2006. Optimization of anaerobically digested distillery molasses spent wash decolourization using soil as inoculums in the absence of additional carbon and nitrogen source. J. Biores. Technol., **97**(16): 2131-2135.

Bartkowiak A., Lemanowicz J., Rydlewska M., Drabinska O. and Ewert K., 2022. Enzymatic activity of soil after applications distillery stillage. Agriculture, **12**: 652-666.

Bharti P.K., Tyagi P.K. and Singh V., 2014. Assessment of heavy metal in the water of Sahastradharas hill stream at Dehradun, India. I. J. Environ., **3**(3): 164-172.

Chandraju S., Nagendraswamy R., Girijanagenrdaswamy and Chidankumar C.S., 2015. Studies on the Impact of Irrigation of Distillery Spentwash on the Yields of Tuber/Root Medicinal Plants. Biomedi. Pharmaco. J., **3**(1): 99–105.

Goli J. and Sahu O., 2014. Effect of Distillery Industry Effluent on Fertility of Soil and Crops. I. J. Soil Crop Sci., **2**(3): 039-045.

Jacob L., Selin G., Bibina K.B. and Rose Xavier K.X., 2016. Impact of distillery effluent on the growth and development of *Oryza sativa* L. I. J. Develop. Res., **6**(4): 7326-7329.

Kalaiselvi P., Shenbagavalli S., Mahimairaja S. and Srimathi P., 2009. Impact of biomethanated distillery spent wash on seed germination and seedling growth of dry land crops. Madras Agric. J., **96**: 331-334.

Kapil J. and Mathur N., 2020. The impact of dairy effluent on germination parameters of seeds of Mungbean (*Vigna radiata*) and Black Mustard (*Brassica nigra*). I. J. Econo. Plants., **7**(4): 170-175.

Khalkar K.M., 2021. The impact of distillery effluents on fertility of soil and growth characteristics of *Cajanus cajan* L. (Pigeon pea). I. J. Res. Biosci. Agri. Techno., **17**: 627-633.

Khan M.M., YiYang and Islam-Ud-Din, 2019. Impacts of sugar mill's effluent on soil and plant's seed germination. Punjab, Pakistan. J. Earth Sci. Environ. Studies, **4**(3): 623-637.

Kumar V., 2014. Sugar mill effluent utilization in the cultivation of maize (*Zea mays* L.) in two seasons. J. Waste Manag., pp. 1-12.

Mishra N.K. and Gupta R.K., 2017. Effect of distillery effluent on seed germination and vigour index of an endangered medicinal plant *Rauvolfia serpentina* Benth. I. J. Scienti. Res., pp.27-33.

Pandey S.N., Nautiyal B.D. and Sharma C.P., 2008. Pollution level in distillery effluent and its phytotoxic effect on seed germination and early growth of maize and rice. J. Environ. Biol., **29**(2): 267-270.

Qureshi A.L., Mahessar A.A., Leghari M.E., Lashari B.K. and Mari F.M., 2015. Impact of releasing wastewater of sugar industries in to drainage system of LBOD. Sindh Pakistan. I. J. Environ. Sci. Develop., **6**(5): 381.

Rath P., Pradhan G. and Mishra M.K., 2010. Effect of Sugar factory distillery spent wash (DSW) on the growth pattern of sugarcane (*Saccharum officinarum*) crop. J. Phytology, **2** (5): 33-39.

Reddy S.S., Raju A.S. and Kumar B.M., 2015. Phytoremediation of sugar industrial water effluent using various hydrophytes. I. J. Environ. Sci., **5**(6): 1147-1154.

Sharma A. and Malaviya P., 2016. Irrigational impact of untreated and treated brewery-distillery effluent on seed germination of marigold (*Tagetes erecta* L.). J. Environ. Biol., **37**(1): 115–119.

Snehlata, Parashar (Sharma) N., Pathak A., Saraswat K. and Sharma R., 2018. Utilization of sewage effluents for irrigation crop plants for sustainable improvement I- percent seed germination and seed germination index in cereal and legume crops. Scientia Ricerca., **2**(6): 487-508.

Umair H.M., Aamer M., Umer Chattha M., Haiying T., Khan I., Seleiman M.F., Rasheed A., Nawaz M., Rehman A., Talha Aslam M., Afzal A. and Huang G., 2021. Sugarcane Distillery Spent Wash (DSW) as a Bio-Nutrient Supplement: A Win-Win Option for Sustainable Crop Production. Agronomy, **11**(1): 183-202.