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Effect of sewage sludge application on the growth and seed germination of wheat crop (*Triticum aestivum* L.)

S.D. NARKHEDE, S.B. ATTARDE, R.P. PATIL AND S.T. INGLE

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See end of the Paper for authors' affiliations

Correspondence to:

S.B. ATTARDE
School of Environmental and Earth Sciences, North Maharashtra University, JALGAON (M.S.) INDIA
Email : sb.attarde@yahoo.co.in

ABSTRACT : Now a day's treatment and disposal of sewage sludge has become a serious problem in the developing country like India. Sewage sludge can be used as growth enhancer for agricultural field at proper concentration for particular crop. This paper examines the effect of sewage sludge application as nutrient source for wheat crop at 5, 10, 15, 20, 25 and 30 per cent concentration with soil matrix. Six pots were prepared of above concentration of sewage sludge and one control. Study of seed germination was done in order to know the germination rate of seeds at various concentration of sewage sludge. Monitoring of wheat growth was done with respect to the plant height, leaf width, number of spikelets, for an interval of 10, 15, 20, 25 and 30 days. At 20 per cent pot concentration height of plant, width size, and no. of spikelet, roots no. and shoot of plant show maximum results whereas at 25 per cent concentration chlorophyll content in plant leaf was higher compared to other pots. Thus beneficial effect of sewage sludge was observed in wheat crop as compared to control sample due to required essential nutrients as well as trace metals in the sludge acts as growth enhancer in some crops like wheat. These imply that the use of sewage sludge at proper concentration as a manure could be more effective and economical to increase the yield of crops on sustainable basis.

KEY WORDS : Sewage sludge, Toxicity, Wheat crop, Germination

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Uncontrolled and inadequate disposal of sewage sludge has resulted in a serious threat to living habitat as well as an environment. Sewage sludge application to agricultural fields is now very common exercise which is effective long-lasting amendment in the country. As sludge contain high amount of organic carbon and vital plant nutrients it may affix or replace the use of chemical fertilizers for crop production. Sewage sludge disposal in a manner which is not harmful to the environment, minimizes health risks and also is economically feasible has become a concern in many parts of world. Use of sludge as a soil conditioner or fertiliser application is widely recommended as it contains a higher proportion of nutrients as well as organic matter (Bettiol, 2004). Application of sewage sludge improves the physical, chemical and biological properties of soils (Aggelides and Londra, 2000, Benitez *et al.*, 2001, Parkpian *et al.*, 2003). It improves water retention in sandy soils and promotes soil structure in clayey soils by increasing the stability of soil aggregates. Use of sludge as manure is a cost effective task for farmers. Also, the disposal problem of sludge will be reduced. Recognizing chemical composition of sewage sludge is most useful requirement when developing recommendations for the rates of sludge applications on agricultural land (Beltran *et al.*, 1999). Availability of nitrogen depends on treatment of sludge. Dewatered untreated sludge releases nitrogen slowly which supports growth of crops over a long time. Concentrations of metal in the soil after sludge applications produce significant increase in trace metals concentrations in the eatable crops grown. Concern must be taken while applying sewage sludge to land to preclude any adverse environmental impact. Trace metals such as copper, nickel, manganese, zinc and magnesium present in sewage sludge show their beneficial effects only when they are in appropriate levels as higher concentrations may cause phytotoxicity in plants as well damaging soil quality this will ultimately leads to make an environmental impairment. Due to excessive application of sewage sludge in the fields, factors such as plant toxicity and accumulation of heavy metals affects the soils (McGrath *et al.*, 2000).

The main objective of the study was to assess the desirability of sewage sludge to supply the required plant

nutrients from various concentrations and to know at which concentration of sludge wheat plant shows maximum yield as compared to control pot. Thus the observed results suggest that sludge at optimum level may act as growth enhancer in crop like wheat. Also, the lacking of soil nutrient may get compensated by the application of sludge in appropriate amount.

METHODOLOGY

Collection of semi solid sewage sludge was done from local waste stream of the city. Physicochemical analysis of sewage sludge was done in the laboratory and parameters like pH, conductivity, organic matter, nitrogen, potassium, phosphorus, chlorides etc. were determined as per the standard methods described in (APHA, 1995). Suspension of 1g sludge with 5 ml distilled water was made for physicochemical analysis of sludge. Heavy metals like Cu, Mg, Mn, Ni, and Zn were analyzed on Atomic Absorption Spectrophotometer (Sposito *et al.*, 1983). Six plots were prepared for sludge sample and one was common control (C). A mixture with a ratio of 200 g soil + 20 g sludge sample gave 10 per cent concentration plot. Likewise, plots were prepared for 5, 15, 20, 25 and 30 per cent concentrations of sludge. Equal number of wheat (*Triticum aestivum*) seeds was planted per pot and the pots were kept in semi sun rays condition with proper aeration. Water sprinkling was done thrice a day and 60 ml of water was sprinkled at a time on each plot. Chlorophyll content of the plant leaves was estimated Spectrophotometrically (Arnonymous, 1949).

RESULTS AND DISCUSSION

Sewage sludge analysis was done in triplicate (n=3) to know the exact composition of macro and micro nutrients of soil (Table 1). Sludge was having pH 7.6 which indicates semi-neutral nature. Nitrogen and phosphorus were 1.4 per cent and 0.74 per cent, respectively in sewage sludge which suggests that it is suitable for the agricultural use, whereas potassium content observed in sludge composition was 0.44 per cent which is much lower than crop requirement. Mg and Fe were found to be in adequate concentration in the sewage sludge which indicates its potential as micronutrient supplier followed by Mn, Cu, Ni and Zn.

Table 1 : Characteristics of sewage sludge (n=3)

Parameter	Value (Mean±SD)
pH	7.6±0.1
Organic carbon (%)	37.2±0.3
Total solids (mg/l)	29,100± 3.2
C:N ratio	26.57±0.2
Chloride (%)	2.3±0.2
COD (mg/l)	1250±3.6
Nitrogen (%)	1.4±0.1
Phosphorus (%)	0.74±0.01
Potassium (%)	0.44±0.01
Nickel (%)	0.00002±0.3
Magnesium (%)	0.00129±0.1
Zinc (%)	0.00002±0.5
Manganese (%)	0.00065±0.2
Copper (%)	0.00011±0.1
Iron (%)	0.00202±0.5

Maximum results for various parameters observed were obtained at 20 per cent concentration of sewage sludge in 10, 15, 20, 25 and 30 days after sowing (DAS) followed by 25 per cent and 30 per cent concentrations of sewage sludge. Control pot had shown the lowest plant growth compared to sludge treated pots (Fig. 1, 2 and 3). This is due to the fact that sludge contains essential macro and micronutrient which act as growth enhancer for the plants at suitable concentration. Similar results was observed in other parameters of plant studied *i.e.* leaf width and no. of spikelets. Highest leaf width

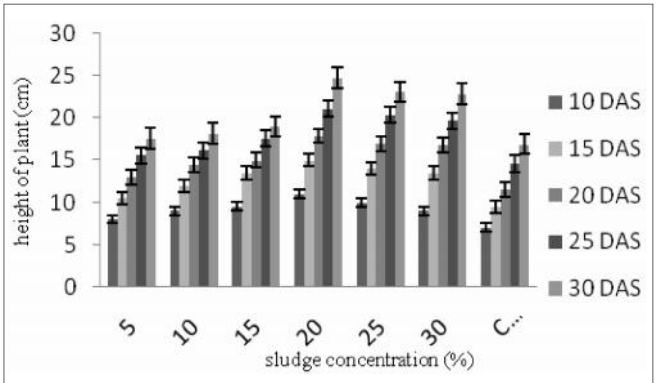

Fig. 1 : Plant height at various concentrations of sewage sludge (n=3)

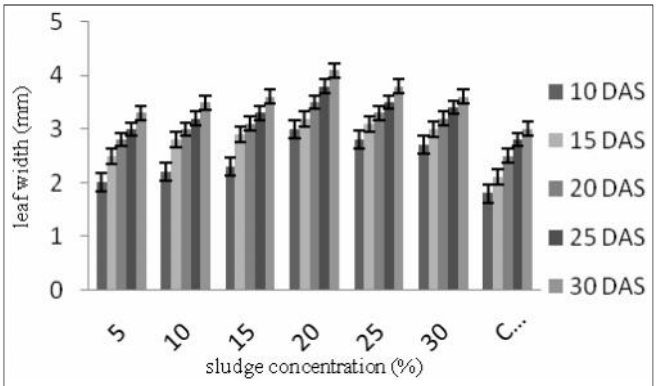

Fig. 2 : Leaf width of wheat plant after application of sewage sludge (n=3)

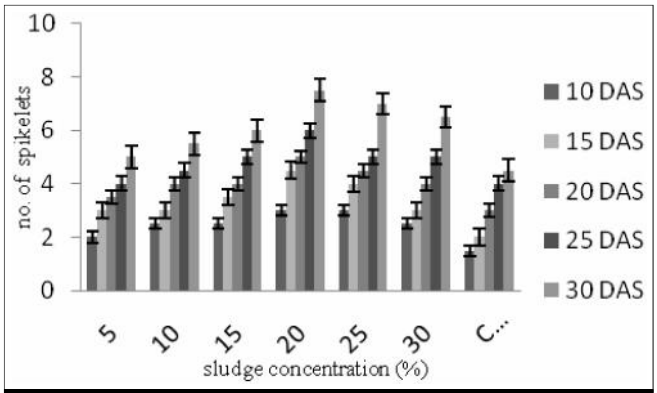

Fig. 3 : No. of spikelets of wheat plant after application of sewage sludge at various concentrations (n=3)

and number of spikelets were recorded at 20 per cent concentration of sewage sludge followed by 25 per cent and 30 per cent (Fig. 2 and 3, respectively) which indicates above 20 per cent sludge concentration, plants were incapable to utilized the available plant nutrients present in sewage sludge which resulted in lowering the growth. Also, below 20 per cent concentration due to insufficient available plant nutrients the growth of plant was low as compared to 20 per cent concentration of sewage sludge.

Chlorophyll content at 30 DAS was 2.5 per cent which was found to be maximum in 25 per cent concentration pot followed by 20 and 30 per cent (Fig. 4). Control pot had shown the lowest chlorophyll content of 1.2 per cent compared to the other sludge applied pots. This clearly indicates that the effect of sludge not only increases plant height and leaf width but also is capable of enhancing the chlorophyll content in leaf of wheat crop. Number of roots and shoots were found to be higher in 20 per cent concentration pot of sludge followed by 25 and 30 per cent (Fig. 4). This is due to suitability of

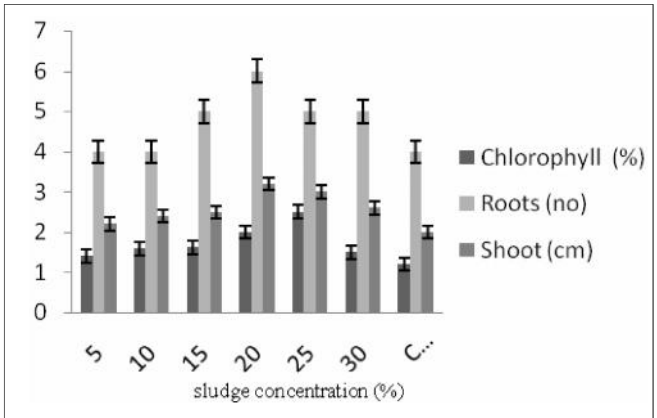

Fig. 4 : Chlorophyll content, no. of roots and shoots of wheat plant after 30 DAS (n=3)

applied dose which has enhanced overall growth of plant at 20 per cent concentration of sewage sludge. Seed germination studied was done at 5 DAS, in which out of total equal seed sown in each pot the germination was higher in sludge applied pot. At 20 per cent concentration of sludge highest germination was observed followed by control, 10, 25, 05, 15 and 30 per cent concentration of sludge (Fig. 5). Sewage sludge recycling for agricultural land is considered as the best feasible environmental option (Anoymous, 1996).

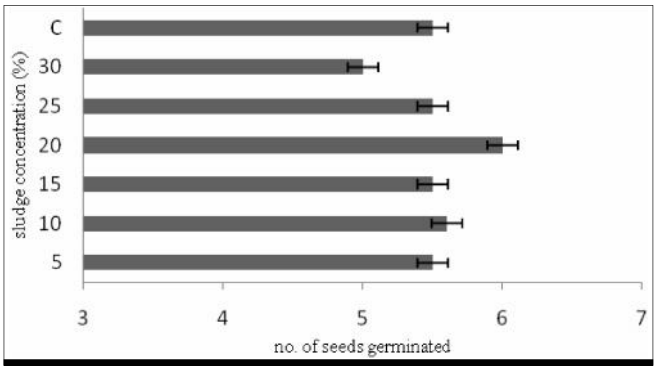

Fig. 5 : Seed germination of wheat plant after 5 DAS

Conclusion:

Promising results are obtained after application of sewage sludge compared to control pot. At 20 per cent application of sewage sludge maximum plant height, leaf width, number of spikelets, number of roots and shoots were recorded, whereas at 25 per cent concentration chlorophyll content was high compared to other treatments. Also, 5, 10 and 15 per cent applications of sludge in pots were effective against control pot as lowest result values were recorded from it compared to all other sludge applied pots. Hence, use of sludge was found to be effective for growth of wheat crop at various concentrations. Thus results obtained reveals that by knowing sludge composition prior to its application in field will allow to make decision about its use as a fertilizer and accordingly can be recommended at suitable concentration for the particular crop.

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Authors' affiliations:

S.D. NARKHEDE, R.P. PATIL AND S.T. INGLE, School of Environmental and Earth Sciences, North Maharashtra University, JALGAON (M.S.) INDIA

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