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IMPACT OF COALMINE INDUSTRIAL EFFLUENTS ON PRODUCTIVITY OF PULSE CROP

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ABTRACT

Pulses are the basic Ingredient in the diets of a vast majority of the Indian population, as they provide a perfect mix of vegetarian protein component of high biological value when supplemented with cereals. Despite several initiatives taken by the Government for improving the productivity and reducing the cost of production of pulses, still the requirements are more than availability of pulses. Short fall in pulses has been attributed to a number of f actors, the major ones being the increasing population, abrupt climatic changes, disease – pest syndrome etc. This article describes present status of pulses crop, and to suggest measures to achieve sustained pulses production in the country. Besides, a small test has been conducted to examine the impact of coal mine effluents on productivity of Bengalgram (chick pea),the dominant pulse crop in Iindia.

KEYWORDS

coalmine industrial effluents, pulse crop.

INTRODUCTION

Pulses occupy an important position in developing countries in general and India in particular. They figure prominently in crop mixtures and crop rotation and occupy a vital role in the dietary of the people. It supplies the major portions of the protein requirements. Pulses have protein three times as much as cereals. A mixed diet of cereals and pulses has high biological value. Pulses are also an excellent feed and fodder for livestock. Endowed with the unique ability of biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement and capacity to withstand harsh climate, pulses have remained an integral component of sustainable crop production system since time immemorial, especially in the dry areas. They also offer good scope for crop diversification (growth profitably in relatively low-input management conditions) and intensification (short growing period) Legumes also provide a source of dietary protein fertilizer for cereal crops, grown as rotational crops particularly when the straw is not harvested. Pulses are mostly grown under unirrigated conditions on poor soils and with low inputs. Pulses do not require large dozes of fertilizers and pesticides. Out of about 23 million hectares of area under pulses, only 2-3 million hectares are irrigated.

PRESENT STATUS OF PULSE CROPS

The biggest increase in area under pulse crop and production during 2000-01 to 2010-11 can be observed from date presented in Table-1, however, growth rates of yield during this period is declined marginally compared to earlier decade. During 2010-11, of the total food grain production, production of cereals was 226.54 million tones (mt) and pulses 18.24 mt.

As per second advanced estimates for the year 2011-12, provided by the Department of Agriculture and cooperation total food grains production projected at a record level of 250.42 mt. and pulses at 17.28 mt. These figures make India the largest producer of pulses in the world, with 24 percent share in the global production.

TABLE – 1: AVERAGE GROWTH RATES IN AREA, PRODUCTION AND YIELD OF PULSE CROP IN INDIA SINCE INDEPENDENCE

Year	Growth Rates(%)		
	Area	Prod.	Yield
1949-50 to 1964-65	1.72	1.41	-0.18
1967-68 to 1980-81	0.44	-0.44	-0.40
1979-80 to 1989-90	0.15	2.78	2.63
1989-90 to 1998-99	-0.22	0.75	0.65
1949-50 to 1998-99	0.16	0.58	0.46
1990-91 to 1999-2000	-0.91	1.06	1.82
2000-01 to 2010-11	2.30	4.02	1.21
Source: Agriculutre Statistics at a Glance - Various Issues			

With the large population dependent on pulses for protein requirements, India is also the largest consumer and importer of pulses. Ironically, the country's pulse production has been hovering around 14-15 Mt. coming from a near-stagnated area of 22-23 M ha, since 1990-91. During this period, an additional population of 350 million has been added, which led to a sharp decline in the availability of pulses from 41 in 1990-90 to 33 g/capita/day in 209-10, doubling its import (from 1.27 to 2.35 million) and resulting in skyrocketing prices. Shortfall in pulses has been attributed to a number of factors, the major ones being the increasing population, rising income, geographical shift, abrupt climatic changes, complex disease-pest syndrome, socio-economic conditions and poor marketing opportunities(Masood Ali and Sanjeeva gupta, 2012).

TABLE-2: REQUIREMENT, PRODUCTION AND IMPORT OF PULSES IN INDIA

Year	Population (million)	Requirement (Mt)	Production (Mt)	Import (Mt)
2000-01	1027	16.02	11.08	0.35
2004-05	1096	17.10	13.13	1.31
2009-10	1175	18.33	14.60	2.83
2020-21	1225	19.10		
2050-51	1613	26.50		

Source: Current Science vol.102.No.6. 25 March 2012

As against total pulse requirement of 18.33 Mt for 2009-10, the domestic production is only 14.60 Mt. provides only partial relief and checks escalation in the market price. By 2050, the domestic requirement would be 26.50 Mt (Table 2), necessitating stepping up production by 81.50% i.e. 11.9 Mt additional produce at 1.86% annual growth rate. The additional production of 7.90 Mt has to come through productivity enhancement and the rest (2.50 Mt) from horizontal expansion in area. The growth rate of pulse production was just 1.52% in the 1980s and 0.59% in the 1990s. It has significantly increased to 1.42% during 2001-08. At present the growth rate in production is only 0.6%. The growth rate in the total area under pulses was negative both in the 1980s and 1990s. Assuming that the area remains constant, as seen during last four decades, 2.05% annual growth rate in productivity will be required to achieve 26.5 Mt by 2020. Some

states like Andhra Pradesh, Maharashtra and Karnataka have already demonstrated high productivity growth in chickpea (51-125%) and pigeonpea (64-110%) during 1991-93 to 2006-08(Nandarajan, and Gupta,S 2010). This assures that the targets as shown in projections can be achieved with appropriate technology back-up and special efforts for promotion of production in the country.

TABLE-3: EFFECT OF COALMINE EFFLUENT ON MORPHOLOGICAL TRAITS OF CHICER ARIETINUM (L)

	Concentration in Percentage	Shoot Length (cm)	Root Length (cm)	No. of Leaves	No. of Lateral roots	*Percentage of Germination
	Control	5.38	11.42	2.1	15.7	100
	25%	2.01	5.73	1.2	5	100
8 Hours	50%	2.07	3.41	1.4	4.3	100
	75%	3.28	4.95	1.4	5.2	100
	100%	4.23	8.12	1.2	8.4	100

Note: For parameter * data taken after 5 days, for the rest it is for 10 days.

Keeping in view the importance of pulses in food grain production, the study examines the effect of coal mine industrial effluents on productivity of Bengal gram (Chick-pea) - the dominant pulse crop in India.

BRIEF PROFILE OF SINGARENI COAL INDUSTRY

Singareni Collieries Company Limited (SCCL) is the oldest public sector Coal Company in India established in 1850 carrying on the mining operations in the Godavary Valley of Andhra Pradesh. It is also known as the South Indian Coal Industry. It is operating in 72 mines and contributing to around 10 percent of country's total coal production. It owns about 6 percent of total national coal reserves. The coal fields of Singareni collieries are spread in 4 districts of Andhra Pradesh – Khammam, Karimnagar, Adilabad and Warangal. The coal production touched to 522 lakh tones during 2011-12. The power industry is the single largest coal consuming sector accounting for about 70 percent of overall consumptions. The ash content is in between 24-45 percent, but low in sulphur (less than 1 percent). In Singareni coal industry, 60 percent of coal production has been extracted by conventional mining methods and the rest from other methods including open cast method.

As part of its responsibility to provide good environment to its workmen and public in the surrounding area of coalfields, SCCL has taken up forestation activities in 3034 hectares of land. In order to reduce / avoid forestland diversion, townships, service building etc. is being planned out side the reserve forest area. To reduce high noise levels around mine sites, in some places, green belt barriers are provided between the mines and the residential areas. However, due to growing demand for housing, tremendous expansion of town ship is taking place in Singreni area irrespective of required permissions from concerned authorities.

Due to the expansion of open cast activities in many mining areas during the last one decade, the dust pollution has been increasing and not only adversely effecting on health of the people but also on crop yield. The Leaves are the main sites for photosynthetic activity. Mining dust particles forms a thin film of dust on the leaves and this leads to the reduced levels of photosynthetic activity; which in turn affects the crop growth.

INDUSTRIAL EFFLUENTS

The soil is a primary recipient of many of the waste products and chemicals used in the industries. Once these materials are enter the soil, they become part of a cycle that affects all forms of life. Biochemical characters of soil such as Alkalinity, Chlorides, Calcium, Magnesium, Organic carbon contents of soil changed and affects the Photo synthesis of plant, stem root growth, length of root, number of lateral roots Biomass, number leaves, Protein, Carob-hydrate and Ascorbic acid etc.

OBJECTIVITIES OF STUDY

i) To examine the present status of pulse crops in India and to suggest appropriate measures for enhancing productivity.

ii) To study the effect of coal mine effluents on germination and seedling growth or productivity of major pulse crop i.e. Bengal gram, as the results may also more or less applicable to other verities of pulses.

iii) To find the effect of coal mine effluents on the metabolic process of pulse crops which changes the nutritive value.

METHODOLOGY ADOPTED FOR TESTING

To know the effects of industrial effluents on the seeds of Bengal gram seeds were treated with different concentrations (25%, 50%, 75% and 100%) of coal mine effluents for 8 hours. Because in normal conditions the plants always receives toxic doses in very diluted conditions. The treated seeds were germinated *in Vitro.* The effluents were collected from the open cast coal mines of Singareni Coal Mining Industry at Yellandu of Khammam district of Andhra Pradesh.

RESULTS AND DISCUSSION

Some adverse effects of the coal mine effluents on morphological characters of major pulse crop *(Cicer arietinum* or Bengal gram) are discussed here under:

- The overall germination percentage is not affected by effluent, however, the emergence of seedling was delayed, due to this duration of time for crop may increase and this may adversely effect on the productivity. Further, unequal growth of seedling may also leads to the lower yield. This study also reveals that the shoot length, root length, number of leaves, number of lateral roots were decreased with the increasing concentrations of coal mine effluents when compare to untreated seeds. This adversely effect on yield.
- The bio-mass (fresh weight and dry weights) was also decreased with the increasing concentration of coal mine effluents. This also reduces the yield of the crop.

The coal mine effluents also shows some deleterious effects on bio-chemical characters (metabolism). They are:

- **Ascorbic acid (vit-c)** plays an important role in the respiratory pattern. It activates the growth centers in the shoot apex. It increases cell division and cell enlargement. The above process leads to differentiation process i.e. shoot apices are converted into reproductive organs (i.e. inflorescence). The Ascorbic acid content was decreased in the effluents treated seedlings. The decreased levels of ascorbic acid shows effect on flowering and seed setting. This leads to the reduced productivity.

TABLE-4: EFFECT OF COALMINE EFFLUENT ON *CICER ARIETINUM (L)* YIELD OF FRESH AND DRY WEIGHTS

	Concentration in Percntage	Fresh Weight (mg)	Dry Weight (mg)
	Controle	9.500	1.800
	25%	6.520	1.950
8 Hours	50%	6.250	1.950
	75%	6.150	1.970
	100%	6.150	1.970

TABLE-5: EFFECT OF COALMINE EFFLUENT ON SOME BIO CHEMICAL PARAMETERS IN *CICERARIETINUM (L)*

	Concentration in Percentage	Amount of sugars (mg)	Amount of Proteins (mg)	Amount of ascorbic acid (mg)
	Controle	19.2 mg/100 g	8.8 mg/100 g	96 mg/100 g
	25%	20 mg/100 g	8.8 mg/100 g	80 mg/100 g
8 Hours	50%	19.2 mg/100 g	8.8 mg/100 g	80 mg/100 g
	75%	20 mg/100 g	19.2 mg/100 g	80 mg/100 g
	100%	19.2 mg/100 g	19.2 mg/100 g	88 mg/100 g

Note: one month old seedlings

- **Sugars:** The sugars plays vital role in organogenesis (formation of leaves and flowers) The total sugars was also increased due to molasses (accumulation). Due to this carbohydrate metabolism gets affected. The carbohydrate metabolism plays a key role during organogenesis. Thus organogenesis was inibited. This results in low production of crop.
- **Protein:** The protein content was increased with the increasing concentration of effluents. This may be due to synthesis of some enzymes involved in stress management. This enables the plant to withstand polluted conditions. Due to this, the flowering process is delayed and it has great impact on crop productivity.

CONCLUSION AND SUGGESTIONS

The present investigation reveals that the pulse crop is severely affected by the coal mine effluents in terms of morphological and biochemical traits, which results in low productivity. Besides, the dust particles from mining activity also badly affects the plant growth and yield. Growth and degradation of environment is moving together. Hence, the development strategy should be a high productivity with low pollution. Development of green belt area around the Coal mines and residential area by undertaking plantation and social forestry, Acacia Arabica, coniferous trees, which are best suited to control the negative effects of pollution should be undertaken. As the thermal pollutants released by coal based thermal power stations pose disastrous effects on the eco-system, hence, efforts should be made to tap the energy sources other than conventional sources, such as bio-energy, photo-energy, tidal-energy, geo-energy and wind-energy etc. Excess use of subsidized fertilizer has created imbalance between Nitrogen, phosorous, and potassium (N, P and K) and also adversely affected the soil health. Sensitization of the farmers with the environmental concerns and balanced use of organic and inorganic fertilizers, biomass and controlled use of agro-chemicals through integrated nutrients and pest management maintaining soil health with diversification should receive high priority. Utilization of farm residues and organic waste, as well as rural and urban garbage would go a long way in achieving sustained pulses production. For yield stability and higher productivity farm ponds and community reservoirs need to be created in every village of the pulse-growing districts of the country. Further, efforts are needed to ensure availability of critical inputs like bio-fertilizers, Sulpur, Zink, Bio-pesticides, etc. at the state level. Provisions should be made for easy credit, insurance, attractive minimum support price with procurement and appropriate incentives. Necessary infrastructure needs to be created for processing and value-addition. Besides these measures necessary investment in research is pre-requisite to develop high yielding and multiple disease-resistant varieties.

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