Plant Archives Vol. 22, No. 1, 2022 pp. 217-221 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2022.v22.no1.034

EFFECT OF FLY ASH ON GROWTH OF *VIGNA MUNGO* L.

Rajeev Kumar* and M.M. Pandey
Department of Botany Bipin Bihari P.G. College, Jhansi, 284001 (U.P.), India.
*Email-rajeevdubey1002@gmail.com

(Date of Receiving : 03-11-2021; Date of Acceptance : 17-02-2022)

ABSTRACT

Parichha thermal power plant is a unit of national thermal power plant situated in Jhansi district of Uttar Pradesh India, which uses bituminous coal for electricity generation. After combustion in boilers this coal comes out from the chimneys and get mixed with air then precipitated in the surrounding area in the form of fly ash which is bring together by electronic precipitators. Present work has been taken to work out the effect of different concentrations of fly ash on the growth and yield of *Vigna mungo* L. variety T-9 obtained from certified seed centre. Seeds of *Vigna mungo* L. have been examined under different concentrations of fly ash amended soil. Different plant parameters such as percent of germination, plant height in terms of shoot and root length, fresh weight, dry weight and chlorophyll content have been analyzed along with crop yield. Maximum germination percent i.e. 94% have been recorded from the sample mixed with 25% fly ash and 75% field soil. For other vegetative parameters it has been found that sample 25% fly ash and 75% soil is highly supportive for plant growth. This has been supported by the leaf samples analyzed for chlorophyll content in the fresh leaves, where maximum amount of chlorophyll content has been recorded.

Keywords : Crop yield, Fly ash (F.A.), *Vigna mungo* L.

Introduction

Fly ash is the by-product of national thermal power corporation plants in India and abroad which produced after combustion of pulverized coal in boilers. Every year Indian thermal power plants produce more than 100 million tons of fly ash through consumption of coal which is expected to be 175 million tons in near future (Jambal, 2003). More than 80 coal fired thermal power plants installed at different part of India to generate 58651 MW energy out of 96948 MW, total power generation up to the end of 2000 (TERI, New Delhi 2001, 1-47). The Fly ash is a mixture of crystalline and amorphous phase and generally considered to be a ferro alumino silicate compound with soil minerals (Dwivedy and Jain 2014). Due to its physico-chemical nature fly ash improves the permeability status of soil likes oil texture, reduces bulk density, increases water holding capacity and porosity. Fly ash has also been found to provide micro nutrients like Fe, Zn, Cu, Mo, B, Mn along with macro nutrients like K, P, Ca, Mg, S etc. for better plant growth. Fly ash is beneficial for use in agriculture due to its physical properties and the presence of macro and micro nutrients which are responsible for plant growth (Pandey and Singh, 2010; Verma *et al*., 2014). It is found that fly ash addition in limited ratio with soil improve the soil-texture with respect to physico-chemical parameters. The various studies on fly ash clearly shows that it can enhances the soil fertility in agriculture fields which is known to be boon for the yield of any crop (Singh *et al.*, 2014). Fly ash is better option to replace the chemical fertilizer in agriculture fields of middle and low-income countries.

The present study was done on *Vigna mungo* L. (Urad) crop. It is a leguminous crop which has been used for the making of proteineous food and fodder. It has been reported to be originated in India with a secondary center of origin in central Asia (Pratap and Kumar, 2011). *Vigna mungo* L. (Black gram) is one of the important pulse crop grown throughout India. It is consumed in the form of DAL (whole and split), used as fodder especially for milch animals and also used as green manure crop. High values of lysine make *Vigna mungo* L. an excellent complement with rice in terms of balanced nutrition. India produces about 1.5 million tons of Urad annually in approximately 2.5 million hectares of land area with an average productivity of 800-1100 kg/acer (ICAR, Agri E. portal, 2020). Urad (*Vigna mungo* L) contains a perfect combination of all nutrients in which protien-25%, carbohydrate-60%, lipid-1.5% with minerals are available (Karamany, 2006). Present experiment has been carried out to study the effect of fly ash on *Vigna mungo* L. variety T-9 with different treatment ratio in soil for measurements of morphological and biochemical changes also with crop yield.

Materials and Method

Experimental site

This agricultural work was conducted during Kharif season in the month of April-July 2019 near the field of Parichha thermal power plant, Parichha away 22 km from

Jhansi through NH-27 as shown in fig.01. Parichha is located at 25°30'51.16"N and 78°45'37.40"E. For above mentioned purpose 6 field plots had been taken with 2×6 square feet area, where 5 plots had been treated with different percent of fly ash such as 10%, 25%, 50%, 75% and 100% as T1, T2, T3, T4 and T5 with total 10 kg weight with soil mixture and remaining one plot was considered as control in which fly ash and soil were mixed by w/w. The seeds of Urad (*Vigna mungo* L.) variety T-9 have been procured from a certified seed center and treated with carbendazim (Fungicide) with 2-2.5 gm/kg ratio then every plot were sowed with 50 seeds of *Vigna mungo* L. variety T-9, shown in figure 02.

Plants were observed daily and measured at 30, 45, 60, 75, 90 and 120th days after sowing. Growth parameters were plant height, chlorophyll amount, leaf area, number of root nodules, number of pods and yield

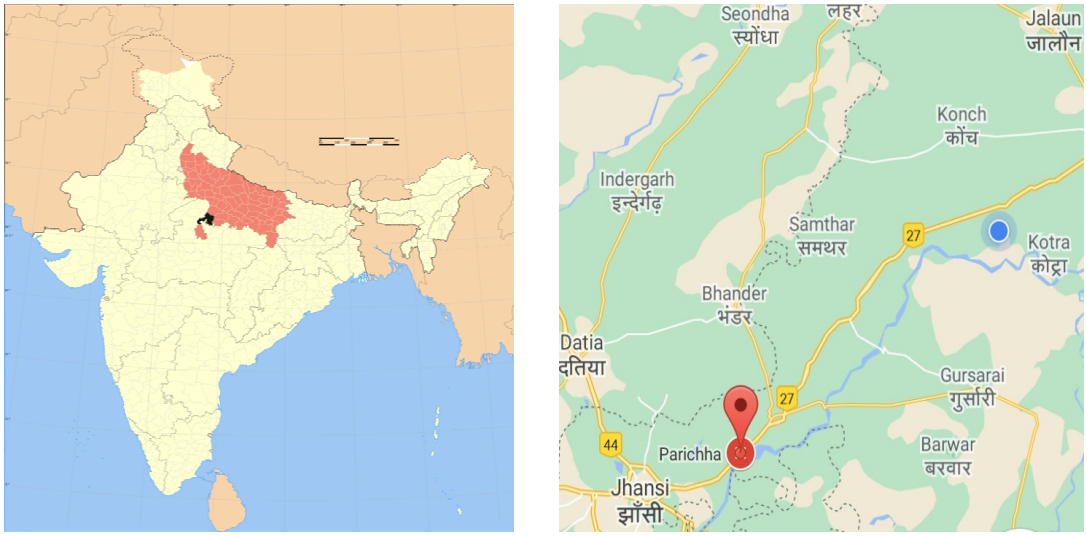

Fig. 1: Map showing location of research area i.e. Parichha (Jhansi district) comes under Uttar Pradesh state of India

(A) (B)

(C) (D)

Fig 2. : (A) fly ash treated Plots (Before Sowing), (B) Seed Germination, (C) Mature Crop in Plots, (D) Morphological view.

(A) Seed germination

Germination percentage of seeds in each plot was recorded carefully after 15 days of sowing.

(B) Plant height

Plant height was measured in terms of root and shoot length in cm at regular time intervals of 30 days, 45 days, 60 days, 75 days and 90 days.

(C) Fresh weight

Freshly uprooted plants were washed thoroughly. After that drying it with the help of filter paper and weigh the material on electronic balance in gm.

(C) Dry weight

Uprooted plant samples were kept at 80°C for 24 hours, and then their weight have been recorded with electronic balance in gm.

(E) Estimation of chlorophyll

The chlorophyll pigment of plants leaves was assessed according to Arnon's (1949) method. For this purpose take 1gm of fresh leaves of urad plants and crushed with the help of mortar and pestle and 10ml 80% acetone were added and then filtered with the help of whatman no.1 filter paper. The extract was centrifuged at 5000 rpm for 5 minutes and the supernatants were collected. The absorbance was recorded at 645 and 663nm by using systronic UV-Visible spectrophotometer against 80% acetone.

Calculate the values for estimation of chlorophyll content-

$$\text{Chl. a (mg/g tissue)} = 12.7\ (A_{663}) - 2.69\ (A_{645}) \times \frac{V}{1000 \times W}$$

$$\text{Chl. b (mg/g tissue)} = 22.9\ (A_{645}) - 4.68\ (A_{663}) \times \frac{V}{1000 \times W}$$

$$\text{Total chlorophyll (mg/g tissue)} = 20.2\ (A_{645}) + 8.02\ (A_{663}) \times \frac{V}{1000 \times W}$$

Where,

V= Final volume of chlorophyll extract

A= Absorbance at specific wavelength

W= Fresh weight of leaves (tissue).

(F) Crop yield

Crop yield was measured in terms of kg from each treated plot including control.

Results and Discussion

(A) Seed germination

Fly ash amended soil enhances water holding capacity and aeration resulting higher germination percentage of seed. Results presented in table 01 and fig. 03 showed that addition of fly ash enhances the seed germination percent. The maximum seed germination percentage was observed in T1 and T2 fly ash treated soil as compared to control and other fly ash treated plots. Similar results were also reported by Aggarawal *et al*. (2004).

Table 1 : Effect of fly ash on seed germination of *Vigna mungo* L.

Fly ash Treatment	No. of Seed Germination (Out of 50)	Germination (%)
Control	44	88
T1	46	92
T2	47	94
T3	38	76
T4	34	68
T5	30	60

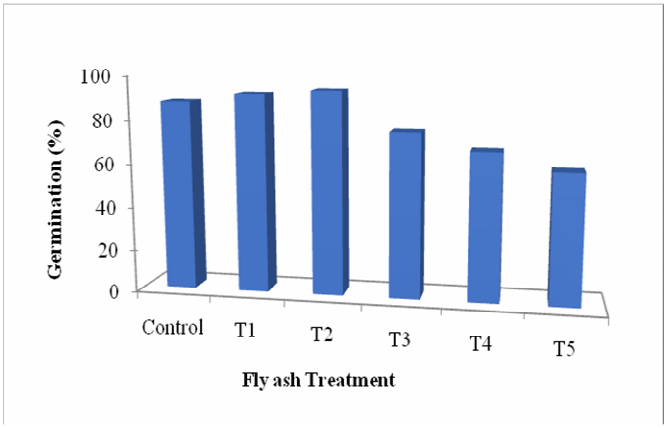

Fig. 3 : Effect of fly ash on seed germination of *Vigna mungo* L.

(B) Shoot and Root length

Data presented in table 02 & 03 and fig. 04 & 05 shows that 25% fly ash treated soil have positive effect on the plant growth in terms of shoot and root length. Fly ash has some physical and chemical properties that might be useful in low level of soil amendment (Verma *et al*., 2014; Ram and Masto, 2014). Our findings are also similar to the findings of Khan (2001) and Parveen *et al.*, 2006 and who concluded that small amount of fly ash addition increases plant length, branches and flowers of plant where as higher percentage reduce them significantly.

Table 2 : Effect of fly ash on shoot length of *Vigna mungo* L.

No. of Days	Shoot Length					
	C	T1	T2	T3	T4	T5
30	8.00	8.30	9.80	8.40	7.80	6.05
45	11.00	10.75	11.15	10.90	10.00	7.40
60	11.40	11.20	12.45	11.15	11.10	10.80
75	12.90	12.85	15.65	12.05	11.62	11.25
90	13.60	14.20	15.90	12.30	11.90	11.75

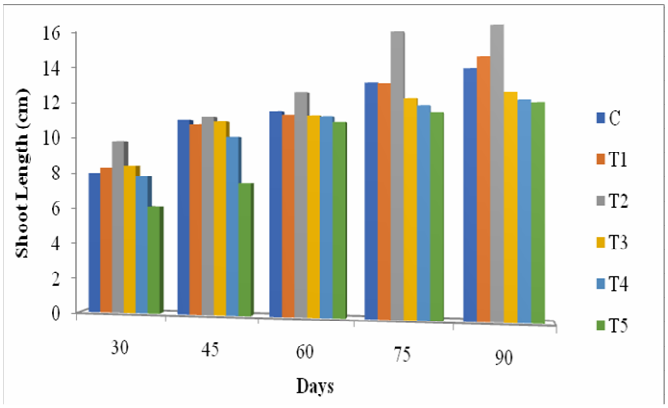

Fig. 4 : Effect of fly ash on shoot length of *Vigna mungo* L.

Table 3 : Effect of fly ash on root length of *Vigna mungo* L.

No. of Days	Root Length					
	C	T1	T2	T3	T4	T5
30	12.60	13.50	16.00	11.00	9.60	9.80
45	15.60	13.85	16.75	12.10	11.70	10.10
60	15.15	14.40	17.15	15.50	14.40	13.10
75	19.35	15.80	20.60	15.65	15.25	14.80
90	20.30	20.10	22.95	18.75	18.50	18.25

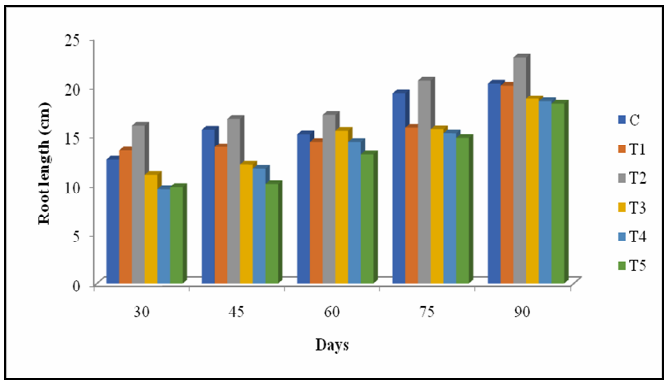

Fig. 5 : Effect of fly ash on root length of *Vigna mungo* L.

(C) Fresh and dry weight

Similarly, the maximum fresh and dry weight was observed from the plant grown in 25% fly ash treated soil as compare to other (Table 4, 5 & Fig. 6, 7). The most suitable treatment for improving black gram growth was T2. In this study we found that fly ash not only improved the physical properties of the soil but also gave the highest plant biomass to *Vigna mungo* L. Singh *et al.* (1997) also reported that lower application of fly ash to the soil stimulate the plant growth with respect of their fresh and dry weights.

Table 4 : Effect of fly ash on fresh weight of *Vigna mungo* L.

No. of Days	Fresh weight (gm)					
	C	T1	T2	T3	T4	T5
30	3.820	5.290	7.990	6.644	4.823	2.215
45	4.817	7.030	13.321	8.743	6.020	2.493
60	13.381	11.462	14.063	13.090	11.054	8.581
75	18.257	21.666	23.360	16.004	15.032	12.231
90	15.717	16.110	18.282	14.324	13.775	9.824

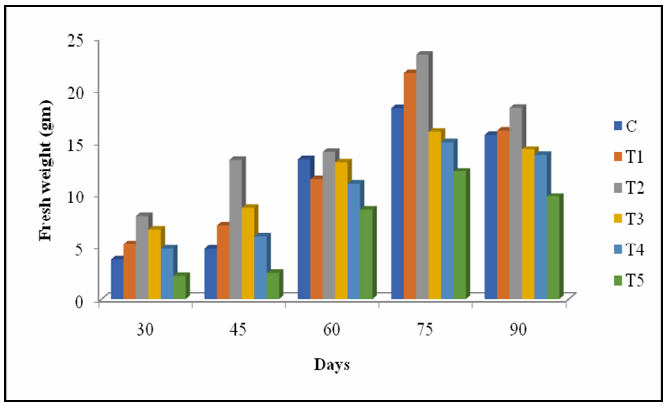

Fig. 6: Effect of fly ash on fresh weight of *Vigna mungo* L.

Table 5 : Effect of fly ash on dry weight of *Vigna mungo* L.

No. of Days	Dry Weight					
	C	T1	T2	T3	T4	T5
30	0.204	0.459	0.660	0.311	0.197	0.121
45	0.804	1.024	2.367	1.361	1.052	0.343
60	2.410	2.780	3.321	2.548	2.856	1.605
75	4.551	5.244	6.197	3.432	3.146	2.261
90	4.532	5.065	6.295	4.265	3.506	2.995

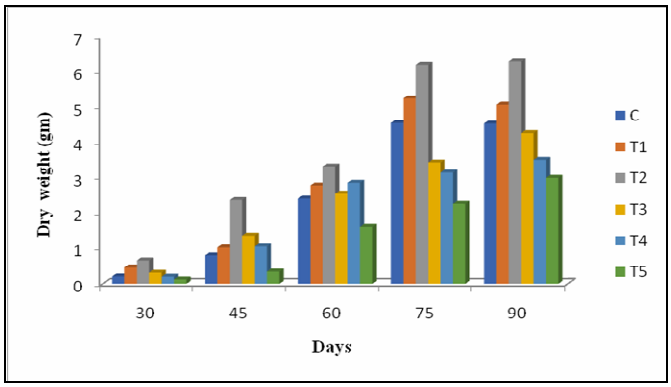

Fig. 7: Effect of fly ash on dry weight of *Vigna mungo* L.

(C) Chlorophyll amount

Total chlorophyll amount in the plants leaves have been shown in the Table 6 and Fig. 8. These results shows that addition of low amount of fly ash in the soil increases total chlorophyll contents. Kumar and Kumar in 2017 also reported the similar results during their research and concluded that this enhancement may be presence of sufficient concentration of macro and micro nutrients in the fly ash.

Table 6 : Effect of fly ash on amount of total chlorophyll of *Vigna mungo* L.

No. of Days	Chlorophyll Amount					
	C	T1	T2	T3	T4	T5
30	0.270	0.266	0.291	0.345	0.287	0.197
45	0.490	0.517	0.537	0.415	0.350	0.285
60	0.506	0.523	0.559	0.423	0.414	0.201
75	0.552	0.573	0.577	0.441	0.374	0.159
90	0.452	0.483	0.568	0.333	0.244	0.133

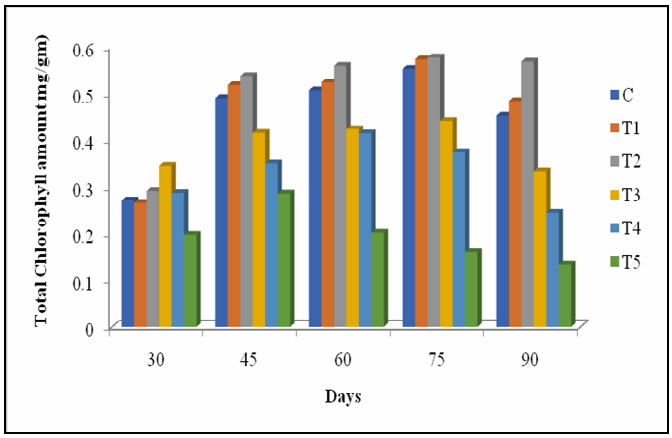

Fig. 8: Effect of fly ash on amount of total chlorophyll of *Vigna mungo* L.

(E) Crop yield

Total yield of *Vigna mungo* L. in present experiment with various fly ash treatments is decorated in the Table 7 and Fig. 9. During this research maximum no. of pods were obtained when plants were grown in 25% fly ash amended soil (T2) with 6-8 seeds in each pod while minimum no. of pods were observed when plants were grown in totally fly ash amended soil (T5).

Table 7: Effect of fly ash on Yield of *Vigna mungo* L.

Fly ash Treatment	Yield (kg)
C	2.644
T1	2.876
T2	3.211
T3	1.862
T4	1.421
T5	0.872

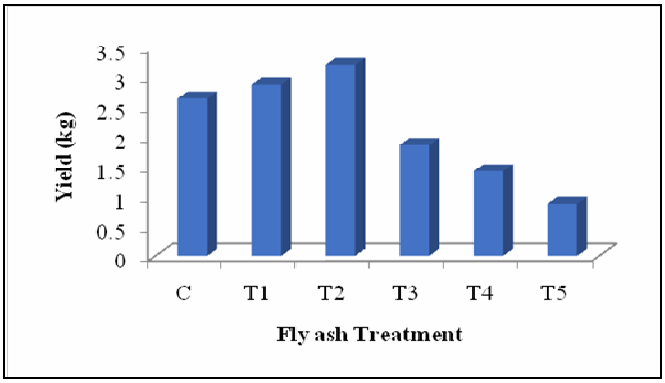

Fig. 9: Effect of fly ash on Yield of *Vigna mungo* L.

So these results clearly showed that addition of small amount of fly ash in the normal field soil increases both growth as well as yield of several crops (Singh *et al*., in 1997 and Khan in 2001). This increment goes upto optimal concentration i.e. 10-25% after that it tended to reduce their productivity. In the present investigation it was also found that at 100% fly ash, yield was considerably reduced. These findings are also accordance with the ICAR, Agri E. portal, 2020.

Conclusion

Fly ash, a by-product of coal combustion regarded as solid waste. Now days it is used in agriculture fields due to the presence of some desired nutrients which can help in plant growth and development. The present investigation shows that small amount of fly ash amendment i.e. 25% in the soil is beneficial for plant growth in terms of plant height, fresh and dry weight, chlorophyll content and their yield production. Therefore present work supports that limited addition of fly ash i.e. 10-25% is beneficial for plant health also with yield of *Vigna mungo* L. crop.

Acknowledgement

The authors are thankful to the Principal of Bipin Bihari College, Jhansi (U.P.) for providing necessary facilities and for his kind support throughout this work.

References

Aggrawal, S.B.; Singh, A. and Bhat, M.M. (2004). Impact of fly ash amendments oil on seed germination growth and yield of *Vigna mungo* L. *Asian J. Microbial Biotech Environment Sci*., 6 (3).

Arnon, D.I. (1949). Copper enzymes in isolated chloroplasts, polyphenoxydase in *Beta vulgaris* L. *Plant physiology*, 24: 1-15.

Dwivedy, A. and Jain, M.K. (2014). Fly Ash waste management and over view (A review). *Recent Research in Science and Technology,* 6(1): 30-35.

ICAR, Agri E. portal, SEP 28, 2020, http://agrigoaexpertses/ black gram. php.

Jambal, N. (2003). Looks the way to utilize Fly ash down to Earth. 12(3): 1-5.

Karamany, E.L. (2006). Double purpose (For age and Seed) of Mung bean production effect of plant density and for age cutting date of forage and seed yield of *Vigna radiata* L. (wilczck). *Research Journal of Agriculture and Biological Science*, 2: 162-165.

Khan, M.R. (2001).Use of fly ash in the cultivation of ornamental plants for domestic purpose. In Upadhyay, S. Nand Mishra, P.K (Eds). Proceeding of the IAEM National conference on recent Advance in waste management. Barzark Information System Pvt. Ltd Varanasi, 85-89.

Kumar, K. and Kumar, A. (2017). Effect of Fly Ash on some biochemical properties of *Vigna mungo* L. *International journal of Pharmaceutical Research and Bioscience*, 6(2): 1-13.

Pandey, V.C. and Singh, N. (2010). Impact of fly ash in corporation in soil systems. Agriculture, *Ecosystem & Environment,* 136:16-27

Parveen, R., Hisamuddin, A.T., Niyaz, T. and Singh, S. (2006). Effect of fly ash amended soil on the plant growth, yield, chlorophyll and oil content of Menthacitrate.

National Symposium on Issue and Challenges for Environmental Management Vision 2025, pp.55.

Pratap, A. and Kumar, J. (2011). Biology and Breeding of Food legumes. CAB international., Oxford shine, United Kingdom,7.

Ram, L.C. and Masto, R.E. (2014). Fly ash for soil amelioration: A review on the influence of ash blending with in organic and organic amendments. *Earth-Science Reviews*, 128: 52-74.

Singh, R.P.; Sharma, B.; Sarkar, A.; Sengupta, S.; Singh, P. and Ibrahim, M.H. (2014). Biological Response of Agricultural Soil to Fly Ash amendment. *Review of Environmental Contamination and Toxicology*, 232: 45-60.

Singh, S.N.; Kulshrestha, K. and Ahmad, K.J. (1997). Impact of fly ash on soil amendment on seed germination, seedling growth and metal composition of *Vicia faba* L. *Ecological Eng*., 9: 203-208.

Verma, S.K.; Singh, K.; Gupta, A.K.; Pandey, V.C.; Trivedi, P.; Verma, R.J. and Patra, D.D. (2014). Aromatic grasses for phyto management of coal fly ash hazards. *Ecological Engineering,* 73: 425-428.