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Studies on Physiological Characteristics of *Sarocladium oryzae* Causing Sheath Rot of Rice

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A B S T R A C T

Studies were conducted in the Dept. of Plant Pathology of Odisha University of Agriculture and Technology, Bhubaneswar for the various physiological requirements of *Sarocladium oryzae* causing sheath rot of rice. It was revealed that Potato dextrose agar supported significantly maximum radial growth (74.0mm) followed by Sabouraud's medium (71.8mm) and Czapek's dox medium (70.0mm). Significantly dry weight of mycelial mat was maximum at pH 4.0 (769.0mg) followed by pH 3.5 (746.6 mg). The highest radial growth was observed in 12 hour light and 12 hour darkness (68.1mm) closely followed by 8 hour light and 16 hour darkness (61.5mm) significantly. Maximum radial growth of *S. oryzae* was observed in 30^0 C (65.0 mm) followed by growth in 35^0 C (58.0mm) significantly.

Introduction

Rice (*Oryza sativa* L.) is a versatile crop which is cultivated for its grain used as staple food in most parts of the world. In Odisha, rice is grown under diverse ecosystems and a wide range of climatic conditions. Jeypore tract in South Odisha has been identified as a putative secondary center of origin of cultivated rice (Ramiah and Ghose, 1951, Ramiha and Rao, 1953).

The potential yield of rice suffers major setback by natural calamities like flood, dry spell and biotic factors like disease pest. Annual yield loss in rice due to pests and diseases is 35-40% (Srinivasachary *et al.*, 2002). Rice suffers from 50 diseases including 21 fungal, 6 bacterial, 12 viral, 4 nematodes and 7 miscellaneous diseases and disorders (Hollier *et al.*, 1993; Webster and Gunnell, 1992; Jabeen *et al.*, 2012).

Among the fungal diseases, sheath rot of rice caused by *Sarocladium oryzae* (Sawada) Gams and Hawksworth (1922), is gaining the status of major disease due to widespread occurrence in almost all rice growing areas of the world including India (Reddy and Gosh, 1985). The yield loss varied from 9.6 to 85%,

depending on the weather conditions during the crop growth-period (Phookan and Hazarika, 1992). After the introduction of hybrid rice varieties, sheath rot is considered as third major fungal disease after blast and sheath blight because of continuous occurrence and heavy yield loss caused by it. The disease occurs in varied temperature and climate.

An investigation was carried out in the Dept. of Plant Pathology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar for the various physiological requirements of *Sarocladium oryzae* causing sheath rot of rice.

Materials and Methods

Growth behaviour of *S.oryzae* in different solid media

In this case fifteen solid media *viz.* Potato dextrose agar, Richard's medium, Brown's medium, Czapek's dox medium, Coon's medium, Kirchhoff's medium, Sabourd's medium, Potato sucrose agar, Yeast dextrose agar, Oat meal agar, Potato rose bangle, Host leaf extract agar, Potato carrot agar, Water agar, Nutrient sucrose agar were taken for testing the growth behavior of *S.oryzae*. Each medium was sterilized at15 p.s.i (121.6ºC) for 20 minutes. After sterilization of total fifteen media, 20 ml of each media was poured in sterilized petridish aseptically.

The effect of different media on fungal growth (*S.oryzae*) was tested in solid conditions. Fifteen days old culture of test pathogen was inoculated at the center of petriplate through sterilized inoculation needle and three replications of each treatment were maintained. These petriplates were incubated at 27 ± 1^0C in incubator and observed periodically. Observation was taken on the radial mycelial growth of the fungus.

Effect on hydrogen ion concentration on growth of *S.oryzae*

In order to study the optimum pH required for growth of the fungus potato dextrose broth was adjusted to different pH levels i.e. pH of 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5,7.0, 7.5, 8.0, 8.5 and 9.0 using a digital pH meter by adding standard sodium hydroxide and hydrochloric acid. One hundred ml of each of the adjusted medium was poured into 250ml conical flasks separately and sterilized by autoclave and then allowed to cool. The pH level of medium after sterilization was found unaltered.

The fungus was inoculated in the broth having different pH, aseptically. Each treatment was replicated three times.

After 20 days of inoculation the mycelia mats were filtered through previously weighed filter papers separately. These mycelial mats along with the filter paper were oven dried at constant 60^0C for 1hour. Then the dry weight of the filtered mass was taken using a digital balance. Finally, the weight of the respective filter papers was subtracted to get the net weight of the fungal biomass and the results were analyzed statistically.

Growth behavior of *S.oryzae* to different light exposure

Optimum growth of test fungus was also carried out in different light period exposure. Twenty days old culture of *S.oryzae* was inoculated in centre of sterilized petridishes containing potato dextrose agar (PDA) for 15 days. Three replications of each treatment were maintained.

These inoculated petriplates were subjected to different light sources, namely, (1) 4hrs exposure to sunlight: - The petriplates were exposed to sunlight immediately after inoculation for 4 hrs and rest of time were

kept on the laboratory table 2 Continuous darkness: - The inoculated petriplates were kept inside the beaker and covered with black cloth for 15 days. (3) Continuous light: - It was kept on the wooden table with 60 watts electrical bulb maintained 50 cm away from the top of the inoculated petriplates. (4) 8hrs darkness and 16 hrs light: - the inoculated petriplates were kept inside the black cloth covered beaker for 8 hrs and on the table for 16 hrs light. (5) 16 hrs darkness and 8 hrs light: - It was also maintained like above procedures. (6) 12 hrs light and 12 hrs darkness: - the alternate light and darkness was maintained by using black cloth covered beaker and electrical bulb. (7) 10 minutes exposed to UV light. (8) 20 minutes exposed to UV light.

For these, the petriplates were inoculated in laminar air flow chamber and exposed to UV light for 10 and 20 minutes immediately after inoculation and kept on the laboratory table. (9) Natural diffused light under laboratory condition: - The alternate light and darkness occurred automatically under laboratory condition. The observation was taken after 15 days of inoculation.

Optimum temperature requirement for the growth of *S. oryzae*

The effect of different temperatures on growth of *S.oryzae* was tested on PDA medium. The potato dextrose agar medium was sterilized and twenty ml of melted PDA medium was poured into sterilized petridish aseptically and allowed to cool. Five mm mycelial disc of 20 days old culture was cut by sterilized cork borer and placed in the centre of each petriplate and three replications were maintained in each case. These were labeled at different temperature *viz.*, 5 ± 1^0, 10±1º, 15±1º, 20±1º, 25±1º, 30±1º, 35±1º and 40±1ºC and incubated in incubator for 15 days. The colony diameter was recorded.

Results and Discussion

Growth behaviour of *S.oryzae* in different solid media

Different sets of solid media were used to study the suitability of the media to support maximum radial growth of the test fungus. Potato dextrose agar supported maximum radial growth (74.0mm) which was significantly the highest among all the media followed by Sabourd's medium (71.8mm) and Czapek's dox medium (70.0mm).Coon's medium and yeast dextrose agar, Richard's medium, potato carrot agar, Kirchhoff's medium, Host leaf extract agar behaved similarly for the growth of *S.oryzae*. Minimum radial growth was observed in potato rose bangle (32.00mm). Prabhakaran *et al.,* (1974) reported that Potato dextrose agar (PDA) as the best medium than Czapeck's medium for the growth of *Sarocladium oryzae.* Mohan and Subramanian (1978) observed that Potato dextrose agar (PDA) and Oat agar (OA) media support the growth of the pathogen significantly better than other media tested. Very good sporulation was observed in PDA, oat agar and Czapeck's dox agar media (Table 1 and Fig. 1).

Effect on hydrogen ion concentration on growth of *S.oryzae*

The test fungus was grown on different pH regime from 3.5 to 9.0. Dry weight of the test fungus was taken after 20 days of inoculation. Significant growth difference was observed among all the pH level with highest mycelial mat of 769.0mg in pH 4.0 followed by 746.6 in pH 3.5. The production of dry mycelial weight was slowly declined from lower pH to higher pH with pH 8.5 recording lowest mycelial weight (404.00 mg). Nearly all the consecutive pH ranges i.e. pH 3.5 and 4.0, pH 6.0, 6.5 and 7.0, pH 7.5 and 8.0, pH 8.5 and 9.0 behaved similarly in supporting the growth

of *S.oryzae*. Mithrasena and Wijesundera (1992) observed maximum growth of *S. oryzae* in pH 3.5. Tasuki and Ikeda (1956) also stated good mycelia growth of sheath rot fungus at pH 6.4 which confirmed the current findings (Table 2 and Figure 2).

Table.1 Growth behaviour of *S.oryzae* in different solid media

Sl. no	Media	Mean radial growth (mm)
1	Potato dextrose agar	74.0
2	Richard's medium	62.2
3	Brown's medium	67.7
4	Czapek's dox medium	70.0
5	Coon's medium	62.0
6	Yeast dextrose agar	62.8
7	Kirchhoff's medium	63.7
8	Sabourd's medium	71.8
9	Potato sucrose agar	67.8
10	Oat meal agar	52.5
11	Potato rose bangle	32.0
12	Host leaf extract agar	63.2
13	Potato carrot agar	60.5
14	Water agar	51.2
15	Nutrient sucrose agar	68.2
	SE(m)±	**1.8**
	CD @ 5%	**5.2**

Table.2 Effect on hydrogen ion concentration on growth of *S.oryzae*

Sl. no	pH level	Dry weight of mycelium (mg)
1	3.5	746.7
2	4.0	769.0
3	4.5	697.3
4	5.0	657.3
5	5.5	580.7
6	6.0	525.3
7	6.5	523.0
8	7.0	518.7
9	7.5	462.3
10	8.0	473.0
11	8.5	404.0
12	9.0	414.0
	SE(m)$^{\pm}$	**13.5**
	CD @ 5%	**39.8**

Table.3 Growth behaviour of *S.oryzae* to different light exposure

Sl. no	Light period	Mean of Radial growth (mm)
1	Sunlight (4hr exposure)	5.7
2	Continuous Dark light	57.6
3	Continuous light	40.6
4	8hr darkness&16 hr light	59.5
5	16 hr darkness&8hr light	61.5
6	12hr light&12 hr darkness	68.1
7	10min exposed to UV light	35.3
8	20 min exposed to UV light	33.0
9	Natural diffused light under laboratory	53.7
	SE(m)$^{\pm}$ **CD @ 5%**	**2.7** **8.0**

Table.4 Optimum temperature requirement for the growth of *S. oryzae*

Sl. no	Temperature (^{0}C)	Mean of radial growth (mm)*
1	5	0.0 (0.71)
2	10	21.0 (4.63)
3	15	30.66 (5.58)
4	20	36.33 (6.06)
5	25	42.0 (6.51)
6	30	65.0 (8.09)
7	35	58.0 (7.64)
8	40	24.66 (5.01)
	SE(m)$^{\pm}$ **CD @ 5%**	**0.10** **0.30**
• **Figures in the parenthesis indicate corresponding √[x+0.5] transformed value**		

Fig.1 Growth behaviour of *S.oryzae* in different solid media

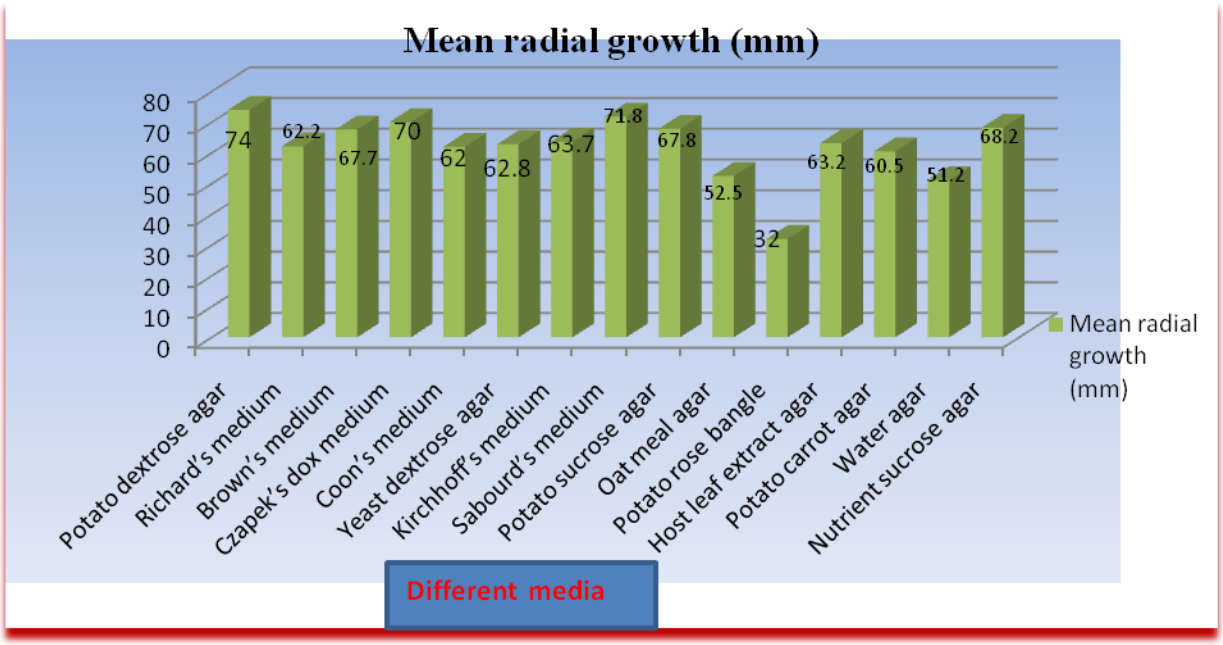


Fig.2 Effect on hydrogen ion concentration on growth of *S.oryzae*

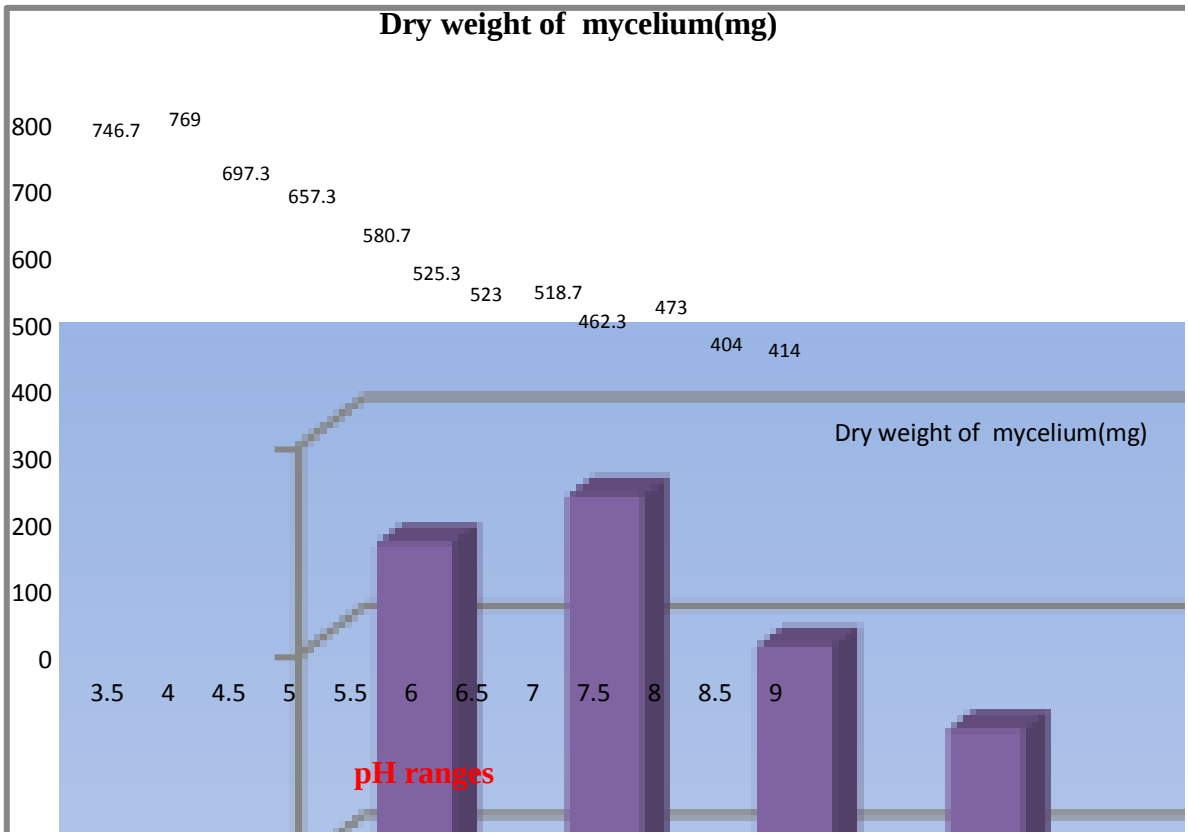


Fig.3 Growth behaviour of *S.oryzae* to different light exposure

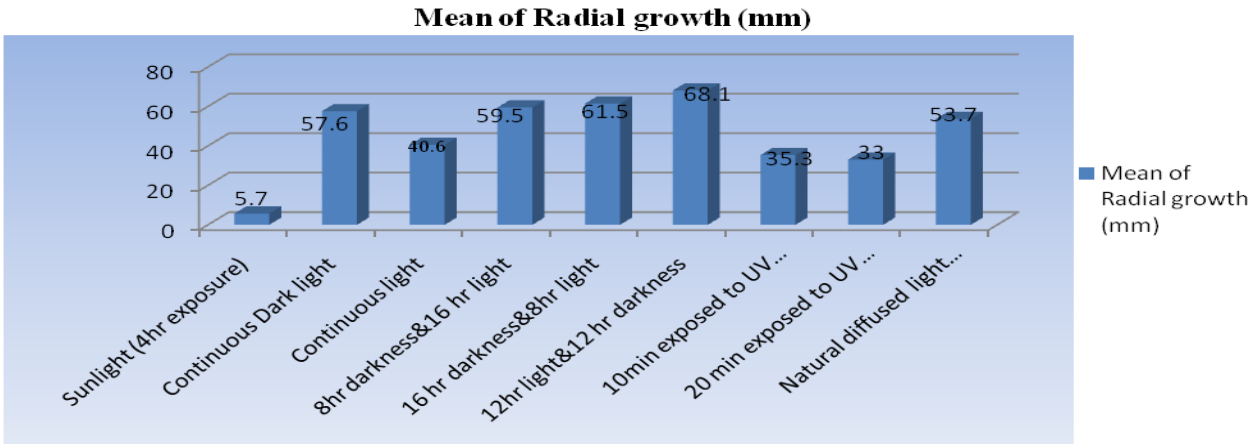
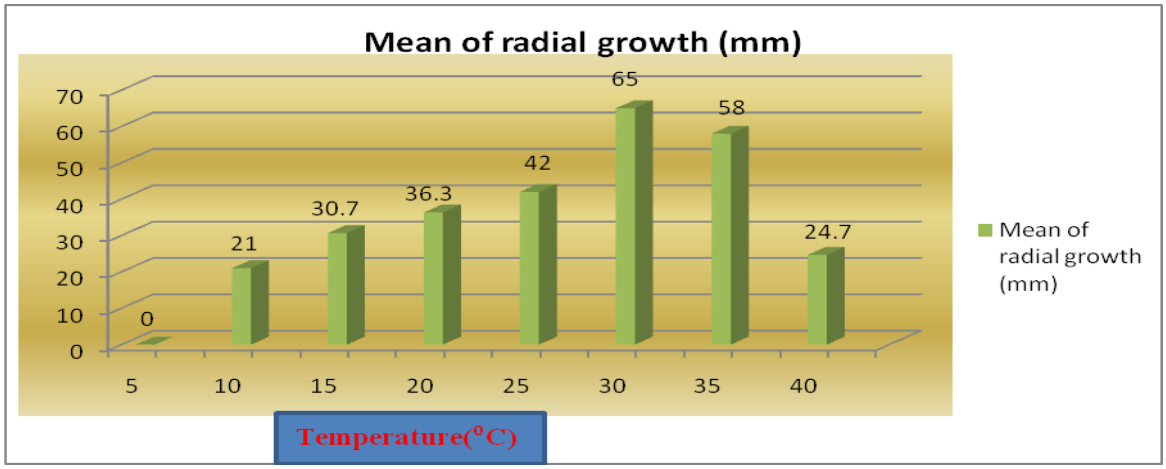


Fig.4 Optimum temperature requirements for the growth of *S. oryzae*



Growth behaviour of *S. oryzae* to different light exposure

Rate of growth of *S. oryzae* was studied in different light exposure.

Varied growth differences were observed among all the light exposure with highest growth of 68.1mm in 12 hour light and 12 hour darkness closely followed by 8 hr light and 16 hr darkness (61.5mm). *S.oryzae* did not respond t bright sunlight and fungal growth was very slow i.e only 5.7 mm in 15 days of growth period. Mithrasena and Wijesundera (1992) revealed that sporulation of *S. oryzae* was enhanced by exposure of fungal colonies to 12 h light and 12 h darkness. The current findings also confirmed the work of above workers (Table 3 and Figure 3).

Optimum temperature requirement for the growth of *S. oryzae*

Growth behaviour of *S. oryzae* in different temperature ranges was also estimated. Significant radial growth difference was observed among all the temperature tested. Maximum growth of *S. oryzae* was observed in 30ºC (65.0mm) followed by growth in 35ºC (58.0mm). Similar growth pattern was recorded by Mohan and Subramanian (1978) i.e. maximum growth and sporulation of the fungus

S. oryzae on oat agar medium. Shahjahan *et al.*, (1977) also got best growth and conidia formation of *S. oryzae* on PDA at 32^0C. In the current study, reduced radial growth was observed as the temperature was increased for 30ºC to 40ºC, but radial growth of *S. oryzae* was increased from 5ºC upto 30ºC with no growth at all at 5ºC (Table 4 and Figure 4).

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References

Hollier CA, Groth DE, Rush MC and Webster RK (1993). Common Names of Plant Diseases. *The American Phytopathological Society*, St. paul, MN.

Jabeen R, Iftikhar T and Batool H. (2012). Isolation, characterization, preservation and pathogenicity test of *Xantomonas oryzae* PV. Causing BLB disease in rice. 44(1): 261-265.

Mithrasena, Y. J.P.K. and Wijesundera, R. L. C., (1992).Growth and sporulation of *Sarocladium oryzae*, the rice sheath rot pathogen, Trop. Agriculturist, 148: 1-13.

Mohan, R. and Subramanian, C. L., (1978). Growth studies on *Acrocylindrium oryzae* Sawada an incitant of sheath rot disease of rice. Madras Agric. J., 65(2): 172-175.

Phookan, A. K. and D. K. Hazarika, (1992). Distribution of sheath rot (ShR) in six agroclimatic zones of Assam, India. IRRN. 17: 16.

Prabhakaran, J., Ragunathan, V. and Prasad, N.N. (1974). Occurrence of sheath rot of rice caused by *Acrocylindrium oryzae* Sawada. Annamalai University Agricultural Research Annual. 4: 182-183.

Ramiah K, Ghose RLM. (1951). Origin and distribution of cultivated plants of South Asia: rice. Indian J. Genet. Plant Breed. 11: 7-13.

Ramiah K, Rao MBVN. (1953). Rice breeding and genetics. *Indian Council of Agricultural Research*, New Delhi.

Reddy, C. S. and A. Gosh, (1985). Sheath rot incidence and yield losses in rice due to the joint infection of rice tungro virus and sheath rot fungus. *Indian Phytopath* 38(1): 165-167.

Sawada, K. (1922). Descriptive catalogue of for mason fungi II, Rep. Govt. Inst. Dep. Agric., Formosa, 2: 136.

Shahjahan, A.K.M., Harahap, Z. and Rush, M.C. (1977). Sheath rot of rice caused by *Acrocylindrium oryzae* in Lousiana. Plant Dis. Reprt., 61: 307-310.

Srinivasachary H, Shailaja K, Girishkumar H.E, Shashidhar and M.G Vaishali (2002). Identification of quantitative trait loci associated with sheath rot (*Sarocladium oryzae*) resistance and panicle exsertion in rice (*Oryza sativa* L.). Current sci., 82: 133-135.

Tasugi, H. and Y. Ikeda, (1956). Studies on sheath rot of rice plant caused by *Acrocylindrium oryzae* Sawada. *Bulletin of the National Institute of Agricultural Sciences* 6: 151-166.

Webster RK and Gunnell PS. 1992. Compendium of Rice Diseases. The *American phytopathological Society*, St. paul, MN. 86.

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