



EFFECT OF PHYSIOLOGICALLY ACTIVE ORGANIC COMPOUNDS LIKE DRUGS ON GROWTH, DEVELOPMENT AND YIELD FORMATION OF RICE (ORYZA SATIVA)

K. ABHIJIT

Main author, Asst. Professor, Department of Chemistry,
Govt. Arts & Science College, Armoor.

P. LATHA

Co-author, Lecturer in Botany, Govt. Arts & Science College, Armoor.

INTRODUCTION:

Plants usually depend on inorganic diet supplied by nature for its nutrition which includes minerals, nitrates, carbon dioxide and water. The source of carbon for the plants is CO₂ from atmosphere. Plants do not depend on organic compounds for carbon source. Even though plants interact with organic compounds and assimilate them depends on the functionality of the compounds. Plants not only interact with persistent organic pollutants like pesticidal substances and their residues but also with pharmaceutical compounds like drugs which are physiologically active organic molecules even in traces.

Physiologically active organic molecules (PAOM) like drugs can interact and involve in plant's physiology and Biochemical system. The extent of absorption and interaction of these PAOM is a function of their structure and polarity of functional groups. The present investigation deals with impact of simple drugs like Aspirin and Paracetamol on oryza sativa using pot culture methods.

MATERIALS AND METHODS:

Determination of Mean Susceptibility concentration (MSC) of Drug:

Mean Susceptibility concentration of Drug is determined by culturing rice plants hydroponically in 100ppm, 50ppm, 20ppm, 10ppm, 6ppm and 2ppm solutions of Aspirin and Paracetamol separately for the period of 7 days. The plants in higher concentration (100ppm and 50ppm) were denatured in two days where as the plants in 20ppm solution denatured in 5days. The plant in 6ppm and 2ppm grows normally for the period of 7 days.

$$\begin{aligned} \text{MSC} &= (20\text{ppm}+10\text{ppm}+6\text{ppm}+2\text{ppm})/4 \\ &=9.5\text{ppm} \end{aligned}$$

Culturing the Rice plants with Drug Treatment:

The pot experiment was conducted in silty loam soil with the alkali-hydrolysable N, P₂O₅, K₂O and 10ppm of Aspirin and Paracetamol separately. The contents are thoroughly mixed. Ten kilogram of soil was placed in each pot (26cm in diameter and 30 cm in height). The pre grown rice plants (5th leaf plant) introduced into above thoroughly mixed soil submerged in water. Fertilizers were applied as a



basal dressing after 3 days (2.0g N, 1.0g P₂O₅, and 1.0g K₂O). These pots were flooded with a water layer of 3cm during whole growth period.

The samples are harvested at maturity and measured for various vegetative and morphological parameters i.e. wet and dry weights of root, shoot, number of tillers, number of leaves per tiller, total leaf area per tiller, stem length, root length, number of grains and seed measurements.

RESULTS:

Effect on plant weight:

Compared to the control, the plant wet weight at maturity was increased by 3.844gm(62.04%) per plant cultivated in Aspirin and 2.34gm(37.7%) per plant cultivated in paracetamol. Whereas in terms of dry weight increases about 0.657gm(22.8%) in case of aspirin and 0.057gm(1.98%) in case of paracetamol. The result suggests that Aspirin and Paracetamol increases Biomass of the plant.

Effect on plant weight:

Compared to the control, the plant stem length at maturity was decreased by 5.67cm(6.27%) and root length increased by 2.43cm(28.15%) plant cultivated in Aspirin. Whereas in Paracetamol stem length at maturity was increased by 20cm (22.14%) and root length increased by 0.43cm (4.98%). This result suggests that Aspirin and Paracetamol have different growth regulating action on stem and similar action on root of the plants.

Effect on tillering and Leaves:

Compared to the control, the number of tillers at maturity was increased by 5.67(34.7%) for the plant cultivated in Aspirin and in case of Paracetamol the number of tillers at maturity was decreased by 4 (24.5%). The total leaf area per tiller increased by 58.65cm²(38.35%) for aspirin cultivation and 26.1cm² (17.06%) in case of paracetamol cultivation. This experimental result clearly states that the Aspirin and Paracetamol both enhances leaf area and inturns increases photosynthetic process.

Effect on Seeds:

Compared to the control, the number of grains at harvesting was increased by 35.33(30.37%) per panicle in the plants cultivated in Aspirin and in case of Paracetamol the number of grains at harvesting was increased by 15.33 (13.17%). There is also noticeable increase in seed length in both instances. This indicates there considerable hike in yield due to treatment of both paracetamol and Aspirin to the rice plants.

<i>Rice plant -wet weight</i>			
	Root weight- (in gm)	Shoot weight (in gm)	Total weight(in gm)
Control			
A	1.02	5.2	6.22
B	1.05	5.23	6.27



C	1	5	6.1
Average	1.023333333	5.143333333	6.196666667
standard deviation	0.025166115	0.125033329	0.087368949
standard error of the mean	0.014	0.072	0.05
	1.023±0.014	5.143 ±0.072	6.196±0.05
Aspirin			
A	1.6	8.54	10.09
B	1.5	8.5	10.02
C	1.4	8.56	10.01
Average	1.5	8.533333333	10.04
standard deviation	0.1	0.030550505	0.043588989
standard error of the mean	0.057	0.017	0.025
	1.5 ±0.057	8.533 ±0.017	10.04±0.025
Paracetamol			
A	1.47	7.12	8.55
B	1.48	7.11	8.56
C	1.35	7.11	8.5
Average	1.433333333	7.113333333	8.536666667
standard deviation	0.059066817	0.005773503	0.026246693
standard error of the mean	0.034	0.002	0.015
	1.433 ±0.034	7.113±0.002	8.536 ± 0.015
values are mean ± S.E(n=3)			
Rice plant -dry weight			
	Root weight (in gm)	Shoot weight (in gm)	Total weight (in gm)
Control			
A	0.22	2.65	2.88
B	0.23	2.66	2.89
C	0.22	2.64	2.86
Average	0.223333333	2.65	2.876666667
standard deviation	0.005773503	0.01	0.015275252
standard error of the mean	0.003	0.005	0.008



	0.223 ±0.003	2.65 ±0.005	2.876 ±0.008
Aspirin			
A	0.38	3.14	3.53
B	0.39	3.14	3.54
C	0.38	3.15	3.53
Average	0.383333333	3.143333333	3.533333333
standard deviation	0.005773503	0.005773503	0.005773503
standard error of the mean	0.003	0.003	0.003
	0.383 ±0.003	3.143 ±0.003	3.533 ± 0.003
Paracetamol			
A	0.28	2.67	2.95
B	0.27	2.66	2.92
C	0.27	2.66	2.93
Average	0.273333333	2.663333333	2.933333333
standard deviation	0.005773503	0.005773503	0.015275252
standard error of the mean	0.003	0.003	0.008
	0.273 ± 0.003	2.663 ±0.003	2.933 ± 0.008
values are mean ±S.E(n=3)			
Rice plant-Seed Measurements			
	Seed Peripheries (in cm)	Length(in cm)	Seed Diameter(in cm)
Control			
A	1.1	1	0.35
B	1.1	1	0.35
C	1.15	0.11	0.364
Average	1.116666667	0.703333333	0.354666667
standard deviation	0.028867513	0.51384174	0.008082904
standard error of the mean	0.016	0.296	0.004
	1.116 ±0.016	0.703 ±0.296	0.354 ±0.004
Aspirin			



A	1.1	1	0.35
B	1.1	1	0.35
C	1.15	1.1	0.364
Average	1.116666667	1.033333333	0.354666667
standard deviation	0.028867513	0.057735027	0.008082904
standard error of the mean	0.016	0.033	0.004
	1.116 ±0.16	1.033 ±0.033	0.354 ±0.004
Paracetamol			
A	1	0.9	0.318
B	1	0.9	0.318
C	0.9	0.8	0.286
Average	0.966666667	0.866666667	0.307333333
standard deviation	0.057735027	0.057735027	0.018475209
standard error of the mean	0.033	0.033	0.01
	0.966 ±0.033	0.866 ±0.033	0.307 ±0.01
values are mean ± S.E(n=3)			
Rice plant -Tillers			
Control	Number of tillers		
A	16		
B	17		
C	16		
Average	16.33333333		
standard deviation	0.577350269		
standard error of the mean	0.333		
	16.33 ±0.33		
Aspirin			
A	21		
B	22		
C	23		
Average	22		
standard deviation	1		
standard error of the mean	0.577		
	22 ±0.577		



Paracetamol	
A	13
B	12
C	12
Average	12.33333333
standard deviation	0.577350269
standard error of the mean	0.333
	12.33 ±0.33
values are mean ±S.E (n=3)	

Statistics of Leaves of Rice plant				
Control	No. of leaves	Leaf length (in cm)	width in cm.	total leaf area per plant (cm)²
A	4	49	1	147
B	4	49	1.1	161.7
C	4	50	1	150
Average	4	49.33333333	1.033333333	152.9
standard deviation	0	0.577350269	0.057735027	7.767238892
standard error of the mean	0	0.333	0.033	4.484
	4±0	49.33±0.33	1.033 ±0.033	152.9 ±4.48
Aspirin				
A	4	62	1.1	204.6
B	4	61	1.1	210.45
C	4	61	1.2	219.6
Average	4	61.33333333	1.133333333	211.55
standard deviation	0	0.577350269	0.057735027	7.560257932
standard error of the mean	0	0.333	0.033	4.365
	4±0	61.33 ±0.33	1.133 ±0.033	211.55 ±4.365
Paracetamol				
A	4	60	1	180
B	4	60	1	180
C	4	59	1	177
Average	4	59.66666667	1	179



standard deviation	0	0.577350269	0	1.732050808
standard error of the mean	0	0.333	0	1
	4±0	59.66 ±0.33	1 ± 0	179 ±1
values are mean ±S.E (n=3)				

Rice Plant -Vegetative parameters			
stem length(cm)			Root length(cm)
Control			Control
A	90		A
B	91		B
C	90		C
Average	90.33333333		average
standard deviation	0.577350269		standard deviation
standard error of the mean	0.333		standard error of the mean
	90.33 ± 0. 33		8.63 ± 0.133
Aspirin			Aspirin
A	85		A
B	84		B
C	85		C
Average	84.66666667		average
standard deviation	0.577350269		standard deviation
standard error of the mean	0.333		standard error of the mean
	84.66 ± 0.333		11.06 ± 0.066
Paracetamol			Paracetamol
A	110		A
B	111		B
C	110		C
Average	110.3333333		average
			9.066666667



standard deviation	0.577350269		standard deviation	0.115470054
standard error of the mean	0.333		standard error of the mean	0.066
	110.33 ± 0.333			9.06 ± 0.66
values are mean ±S.E(n=3)			values are mean ±S.E(n=3)	

Rice Plant –Seed Vegetative parameters	
	No. of grains
Control	
A	116
B	117
C	116
Average	116.3333333
standard deviation	0.577350269
standard error of the mean	0.333
	116.33 ± 0.333
Aspirin	
A	150
B	152
C	153
Average	151.6666667
standard deviation	1.527525232
standard error of the mean	0.881
	151.66 ± 0.881
Paracetamol	
A	135
B	130
C	130
Average	131.6666667
standard deviation	1.000029335
standard error of the mean	0.577
	131.66 ± 0.577
values are mean ±S.E(n=3)	

GRAPHS:

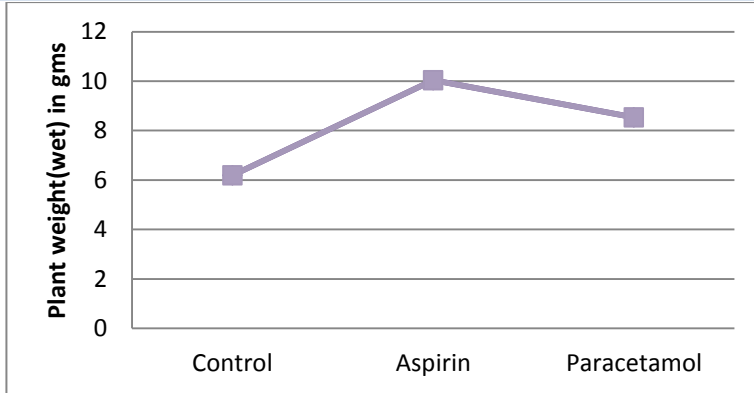


Fig.1. Effect of Aspirin and paracetamol on plant's wet weight

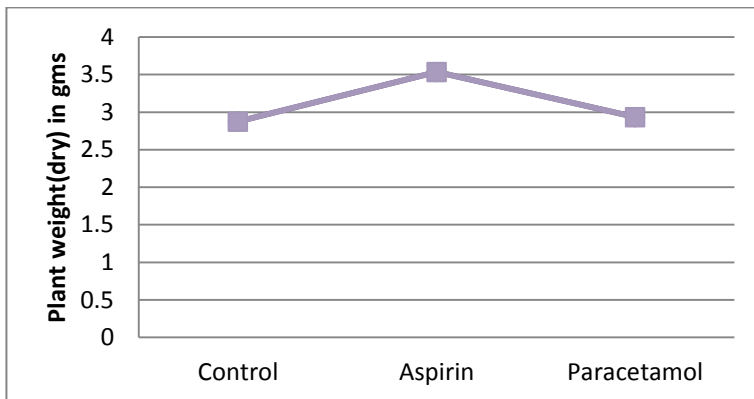


Fig.2. Effect of Aspirin and paracetamol on plant's dry weight

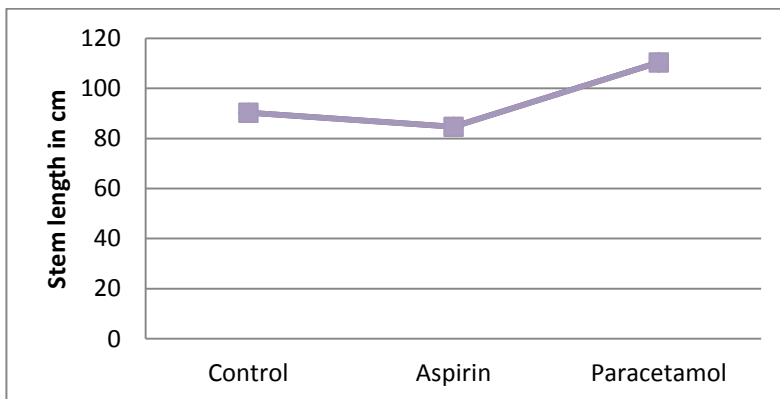


Fig.3. Effect of Aspirin and paracetamol on stem length of plant



Fig.4. Effect of Aspirin and paracetamol on plant's root length

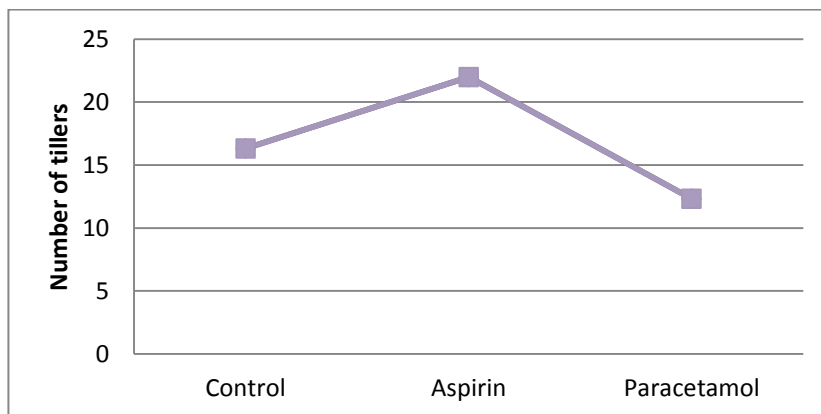


Fig.5. Effect of Aspirin and paracetamol on tillers of the plant

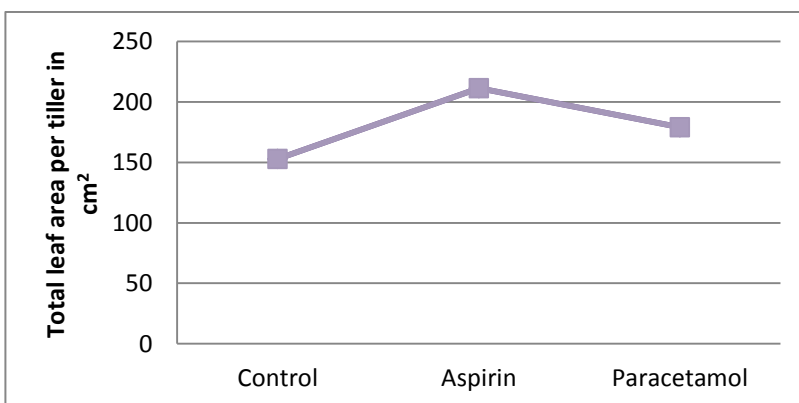


Fig.6. Effect of Aspirin and paracetamol on plant's total leaf area per tiller

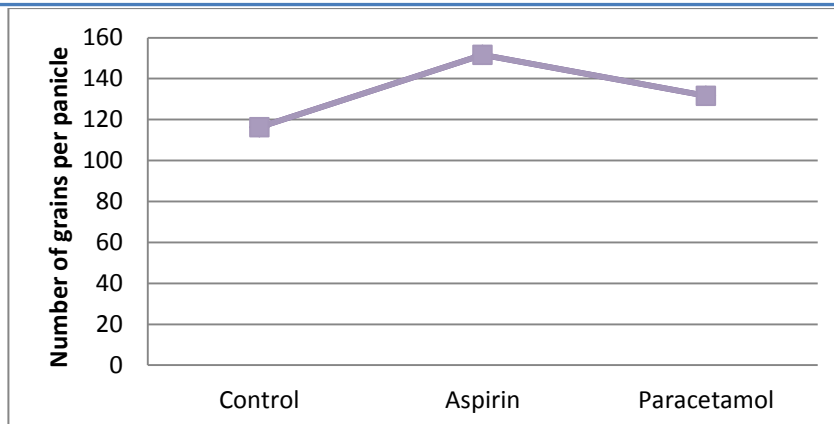


Fig.7. Effect of Aspirin and paracetamol on number of grains per panicle

DISCUSSION:

There was mere research concerning the effects of pharmaceutical drugs on plant growth. The current experiment clearly indicated that Aspirin and paracetamol shows incredible changes in morphological and vegetative parameters of *Oryza Sativa* in many aspects. This is due to either the interaction of these Physiologically Active Organic Molecules directly with phyto-hormones /Growth Regulators or itself acts as growth regulators. The above said drugs gradually degraded by soil bacteria and environmental factors into their phenolic monographs (4-amino phenol in case of paracetamol and Salicylic acid in case of Aspirin) which are more physiologically active as the polarity of functional group increases. This process slowly takes place hence the sequential assimilation by plants will not cause any chemical stress to the plants. The influence of Aspirin and Paracetamol on rice plant increases crop yield (30.37 in case of aspirin and 13.17% in case of paracetamol) basically due to increase in mean leaf area which effectively enhances photosynthesis. This increase in yield initiates new frontiers for Agro-specific research for high yield cultivation strategies. Impact on tillering and number of leaves by these drugs open up the newer strategies for rice cultivation in different arid and semi-tropical conditions.

This experiment reveals that the physiologically active organic molecules (PAOM) like drugs shows significant impact not only on animals but also on plants to various extents.

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