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A Study on Per Cent Survivability of an Agriculturally Important Microbial Consortium in a Selected Formulations

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***Abstract* – A laboratory investigation was carried out to study the survival rate of an agriculturally important microbial consortium (*Azotobacter chroococcum*, *Bacillus megaterium* and *Pseudomonas fluorescens*) in a selected formulations (alginate based, fluid bed dryer, lignite based and liquid) as a single, dual and triple inoculants. After 180 days of storage, the higher survival rate (per cent) of *Azotobacter chroococcum* (94.85 per cent), *Bacillus megaterium* (93.81 per cent) whereas, *Pseudomonas fluorescens* recorded of 95.36 per cent in alginate based formulations. Overall, the maximum viable cells were maintained in the alginate based formulations followed by liquid formulation and lower per cent survival rate of the inoculants were observed in fluid bed dryer based formulations.**

***Keywords* – Alginate, Fluid Bed Dryer, Lignite, Liquid Formulations, *Azotobacter chroococcum*, *Bacillus megaterium*, *Pseudomonas fluorescens*.**

I. INTRODUCTION

The use of Agriculturally Important Microbial consortium benefit crop plants more than single inoculants (Sahara and Nehra, 2011). Hence, the use of mixed inoculants over single inoculant that interacts synergistically is beneficial to enhance and sustain crop production. Development of successful microbial consortia involves a selection of a suitable formulation to support the growth of microorganisms and to maintain a maximum number of viable cells over time of storage, transport and at target. An ideal formulation should be cost effective, non-toxic, easy to process (1). By keeping all these points in view, the present study on per cent survivability of an agriculturally important microbial consortium in a selected formulations was undertaken to provide a concrete information on how the selected formulations play an important role in maintaining the viability of microbial cells in a consortium (2).

II. MATERIAL AND METHODS

The experiment was carried out in the Department of Agricultural Microbiology, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bengaluru–65.

2.1. *Preparation of Different Microbial Consortium Formulations*

Three different agriculturally important microorganisms (*Azotobacter chroococcum*., *Bacillus megaterium* and *Pseudomonas fluorescens*) were prepared in single, dual and triple combination by using four (alginate based, fluid bed dryer, lignite based and liquid) different formulations as suggested by Vijay kumar and Brahmaprakash (2018).

2.2. *Survival Rate Study*

The initial microbial load in each combinations (single, dual and triple) of different formulations (alginate ba-

-sed, fluid bed dryer, lignite based and liquid) were considered as one hundred percent population. Further, per cent survival rate was monitored as suggested by Shilpa and Brahmaprakash (3).

2.3. *Treatment Details*

The experiment was consisting of 7 treatments: T_1 – *Azotobacter chroococcum*., T_2 – *Bacillus megaterium*., T_3 – *Pseudomonas fluorescens*., T_4 – *Azotobacter chroococcum* + *Bacillus megaterium*., T_5 – *Azotobacter chroococcum* + *Pseudomonas fluorescens*., T_6 – *Bacillus megaterium* + *Pseudomonas fluorescens*., T_7 – *Azotobacter chroococcum* + *Bacillus megaterium* + *Pseudomonas fluorescens*.

III. RESULTS AND DISCUSSION

3.1. *Shelf Life of Single Inoculants in Different Formulations*

3.1.1. *Azotobacter chroococcum*

After 180 days of storage, the per cent survival of *A. chroococcum* reduced to 88.99 per cent in alginate based formulation (Fig. 1). The per cent survival of *A. chroococcum*in FBD based formulation after 180 days of storage reduced to 79.61 per cent (Fig. 2). In lignite formulation, per cent survival of *A. chroococcum*, after 180 days of storage reduced to 83.67 per cent (Fig. 3). Whereas, in liquid formulation after 180 days of storage the population was reduced to 92.81 per cent (Fig. 4).

3.1.2. *Bacillus megaterium*

After 180 days of storage, the per cent survival of *B. megaterium* in alginate based formulation was reduced to 93.81 per cent (Fig. 1). In case of fluid bed dryer (fbd) based formulation, the per cent survival of *B. megaterium* was reduced to 90.11 per cent (Fig. 2). The per cent survival of *B. megaterium* in lignite formulation after 180 days of storage was reduced to 80.89 per cent (Fig. 3). Whereas, *B. megaterium* got reduced to 93.81 per cent after 180 days of storage in liquid formulation (Fig. 4).

3.1.3. *Pseudomonas fluorescens*

The per cent survival of *P. fluorescens* in alginate based formulation after 180 days of storage was reduced to 95.46 per cent (Fig. 1). After 180 days of storage, the per cent survival of *P. fluorescens* in FBD based formulation was reduced to 89.93 per cent (Fig. 2). In lignite formulation, the per cent survival of *P. fluorescens* after 180 days of storage was reduced to 88.87 per cent (Fig. 3). Whereas, in liquid formulation, the per cent survival of *P. fluorescens* was reduced to 95.36 per cent after 180 days of storage (Fig. 4).

3.2. *Shelf Life of Dual Inoculants in Different Formulations*

3.2.1. *Azotobacter chroococcum and Bacillus megaterium*

The per cent survival of *A. chroococcum* and *B. megaterium* in alginate based formulation after 180 days of storage were reduced to 88.26 and 93.20 per cent respectively (Fig. 1). In FBD based formulation, the per cent survival of *A. chroococcum* and *B. megaterium* were reduced to 77.34 and 81.49 per cent respectively after 180 days of storage (Fig. 2). The per cent survival of *A. chroococcum* and *B. megaterium* in lignite formulation after 180 days of storage were 85.00 and 84.01 per cent respectively (Fig. 3). In case of liquid formulation, the per cent survival of *A. chroococcum* and *B. megaterium* were reduced to 92.96 and 91.62 per cent respectively after

180 days of storage (Fig. 4).

3.2.2. *Azotobacter chroococcum and Pseudomonas fluorescens*

The per cent survival of *A. chroococcum* and *P. fluorescens* in alginate based formulation after 180 days of storage were reduced to 90.25 and 92.76 per cent respectively (Fig. 1). In case of FBD based formulation, the per cent survival of *A. chroococcum and P. fluorescens* were reduced to 78.72 and 94.56 per cent respectively (Fig. 2). Whereas, in lignite formulation, the per cent survival of *A. chroococcum and P. fluorescens* were reduced to 84.29 and 91.98 per cent respectively (Fig. 3). In case of liquid formulation, the per cent survival of *A. chroococcum and P. fluorescens* were reduced to 95.85 and 93.97 per cent respectively (Fig. 4).

3.2.3. *Bacillus megaterium and Pseudomonas fluorescens*

After 180 days of storage, the per cent survival of *B. megaterium and P. fluorescens* in alginate based formulation after 180 days of storage reduced to 93.06 and 95.06 per cent respectively (Fig. 1). In FBD based formulation, the per cent survival of *B. megaterium and P. fluorescens* were reduced to 88.26 and 87.75 per cent respectively (Fig. 2). The per cent survival of *B. megaterium and P. fluorescens* in lignite formulation after 180 days of storage reduced to 80.89 and 88.87 per cent respectively (Fig. 3). Whereas, the per cent survival of *B. megaterium and P. fluorescens* in liquid formulation after 180 days of storage were reduced to 92.68 and 93.97 per cent respectively (Fig. 4).

A. chroococcum in inoculant 5 (*A. chroococcum* + *P. fluorescens*) maintained maximum cell density after 180 days of survival studies in alginate based formulation whereas, *P. fluorescens* in inoculant 6 (*B. megaterium* +*P. fluorescens*) of alginate based formulation recorded statistically on par cell density with that of inoculant 5 of liquid formulation after 180 days of survival studies.

As a whole, the alginate based formulation supported maximum population of *A. chroococcum, B. megaterium* and *P. fluorescens* followed by liquid, lignite and FBD based formulation. The current results are in agreement with the earlier researchers reports (4), (5), (6), (7), (8), (9).

3.3. *Shelf Life of Triple Inoculants in Different Formulations*

3.3.1. *Azotobacter chroococcum, Bacillus megaterium and Pseudomonas fluorescens*

After 180 days of storage, the per cent survival of *A. chroococcum* (85.89), *B. megaterium* (91.64) and *P. fluorescens* (94.86) were reduced in alginate based formulation after 180 days (**Fig. 1**) in FBD formulation, the per cent survival of *A. chroococcum*, *B. megaterium* and *P. fluorescens* were reduced to 88.33, 92.25 and 90.07 per cent respectively (**Fig. 2**). The per cent survival of *A. chroococcum*, *B. megaterium* and *P. fluorescens* in lignite formulation after 180 days of storage reduced to 91.98, 89.96 and 90.62 per cent respectively (**Fig. 3**). Whereas, in liquid formulation, the per cent survival of *A. chroococcum*, *B. megaterium* and *P. fluorescens* were reduced to 89.94, 88.22 and 92.87 per cent respectively after 180 days of storage (**Fig. 4**).

The population of *A. chroococcum*,*B. megaterium* and *P. fluorescens* as triple inoculants (*A. chroococcum* + *B. megaterium* + *P. fluorescens*) have recorded the significant of differences in all the test formulations.

Pseudomonas fluorescens in the inoculant 7 (*A. chroococcum* + *B. megaterium* + *P. fluorescens*) of alginate based formulation maintained maximum cell density followed by in liquid formulation, lignite whereas, lower

cell density was recorded in FBD based formulation.

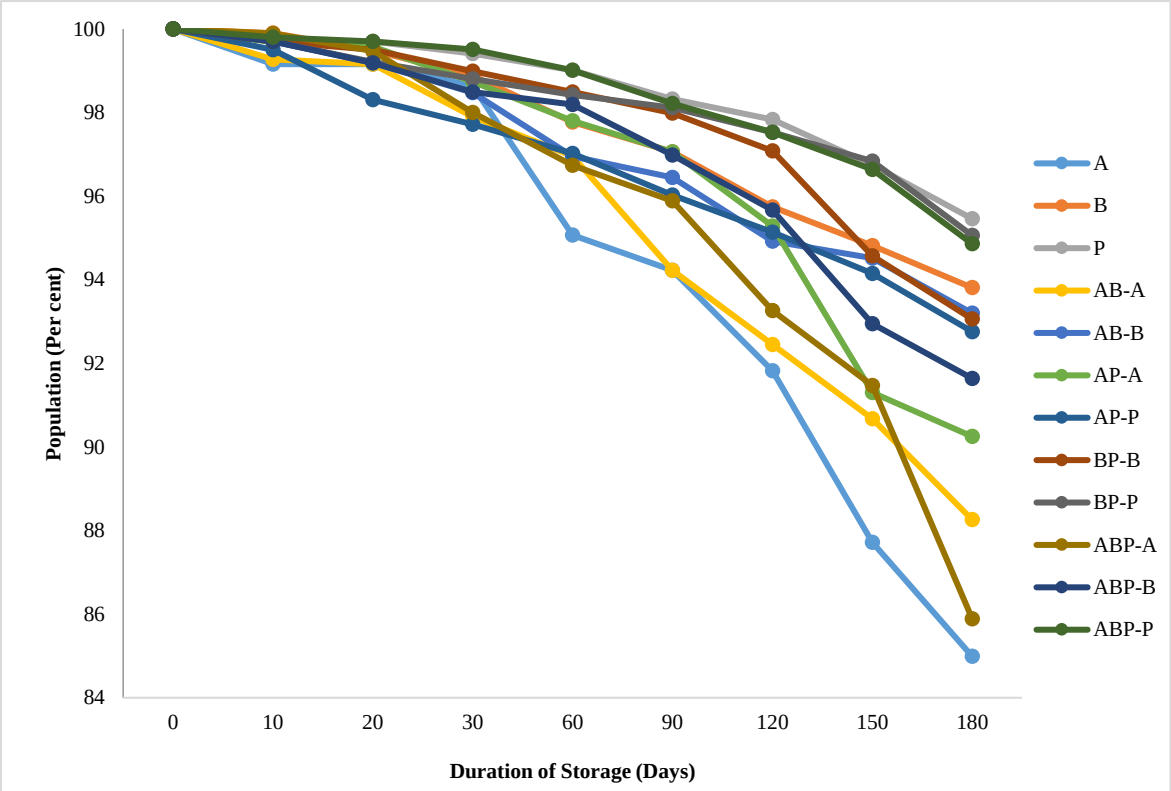

Fig. 1. Per cent survival of microbial consortium in alginate based formulation up to 180 days.

A; *Azotobacter chroococcum*, B; *Bacillus megaterium* P; *Pseudomonas fluorescens*

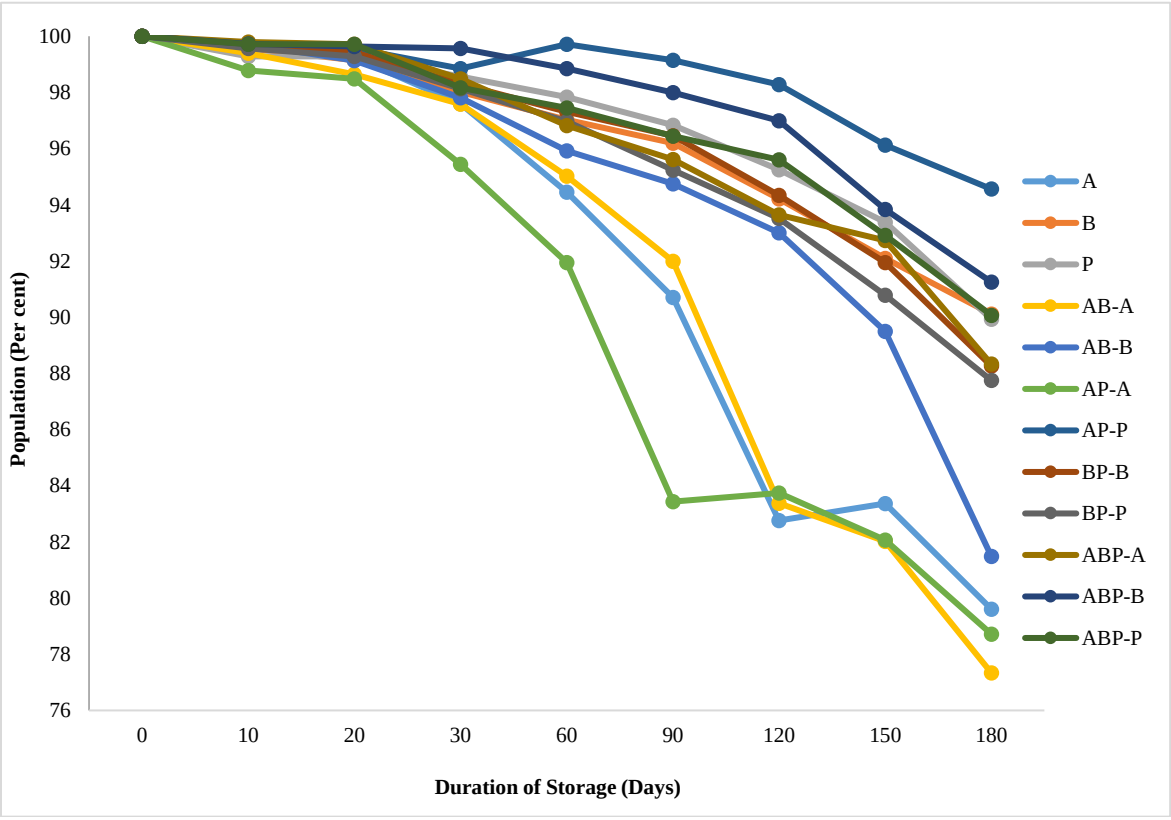

Fig. 2. Per cent survival of microbial consortium in fluid bed dryer based formulation up to 180 days.

A; *Azotobacter chroococcum*, B; *Bacillus megaterium* P; *Pseudomonas fluorescens*

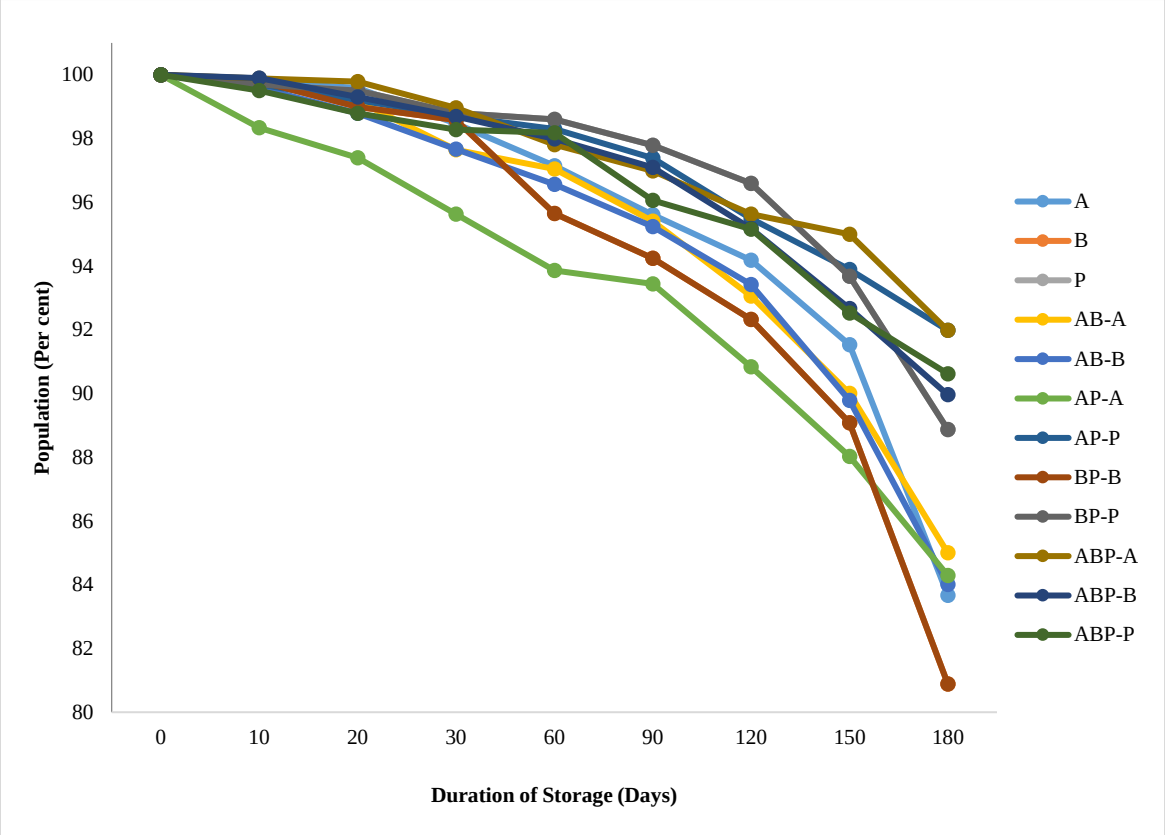

Fig. 3. Per cent survival of microbial consortium in lignite formulation up to 180 days.
A; *Azotobacter chroococcum*, B; *Bacillus megaterium* P; *Pseudomonas fluorescens*

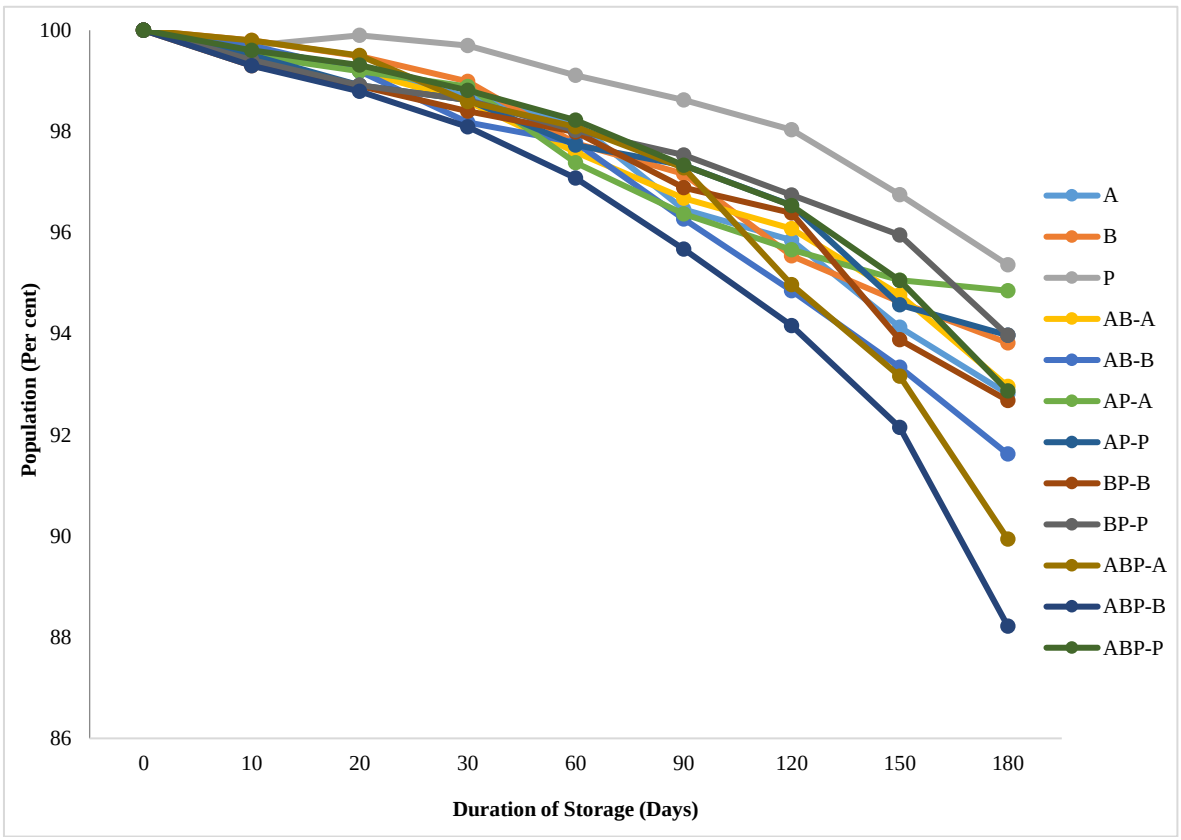

Fig. 4. Per cent survival of microbial consortium in liquid formulation up to 180 days.
A; *Azotobacter chroococcum*, B; *Bacillus megaterium* P; *Pseudomonas fluorescens*

IV. CONCLUSION

Among all the test formulations, the higher per cent survival of the inoculants were observed (after 180 days of storage) in the alginate based formulations and liquid formulations and least was recorded in the fluid bed dryer based formulations. The higher per cent survival rate in alginate based formulation might be due to the reduced metabolic activity of cells by holding the cells inside the bead. Lower cell density was recorded in the FBD based formulations because of hot air passed through the bed for a prolonged time. The similar studies were reported by earlier researchers (10) (11).

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