



# AP Bio

# FRQ Fridays

2017 #2  
Effect of Fire on Plant Growth

# FRQ Friday #29

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Fires frequently occur in some ecosystems and can destroy all above-ground vegetation. Many species of plants in these ecosystems respond to compounds in smoke that regulate seed germination after a major fire. Karrikins (KAR) and trimethylbutenolides (TMB) are water-soluble compounds found in smoke that are deposited in the soil as a result of a fire. KAR and TMB bind to receptor proteins in a seed. In a study on the effects of smoke on seeds, researchers recorded the timing and percent of seed germination in the presence of various combinations of KAR and TMB. The results are shown in Figure 1.

In a second investigation into the effect of available water on seed germination after a fire, researchers treated seeds with KAR or TMB. The treated seeds were then divided into two treatment groups. One group received a water rinse and the other group received no water rinse. The seeds were then incubated along with a group of control seeds that were not treated. The results are shown in the table.

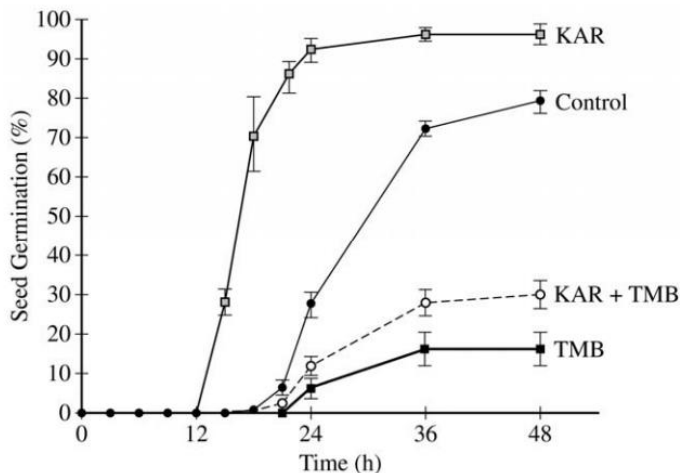


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .

EFFECT OF CHEMICAL TREATMENT AND WATER RINSE ON GERMINATION

Treatment Group	Chemical Treatment		Water	Germination Result
	KAR	TMB		
1 (control)	-	-	-	Control result
2	+	-	-	Different from control
3	-	+	-	Different from control
4 (control)	-	-	+	Control result
5	+	-	+	Different from control
6	-	+	+	Same as control



# FRQ Friday #29

2017 #2

(a) The researchers made the following claims about the effect of KAR and the effect of TMB on seed germination relative to the control treatment.

- KAR alone affects the timing of seed germination.
- KAR alone affects the percentage of seeds that germinate.
- TMB alone affects the timing of seed germination.
- TMB alone affects the percentage of seeds that germinate.

**Provide support** using data from Figure 1 for each of the researchers' claims.

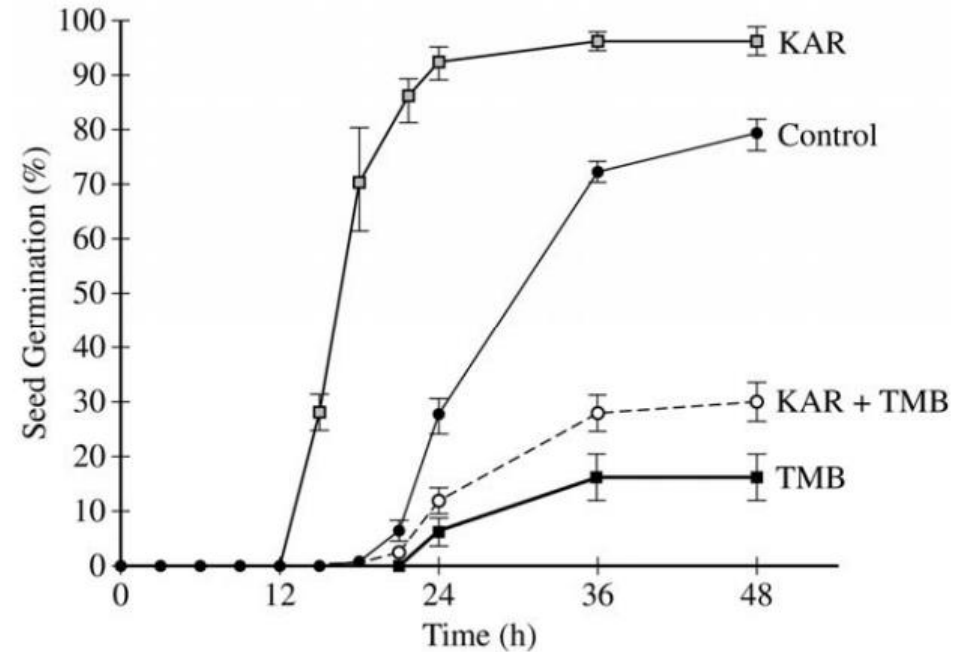


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .



# FRQ Friday #29

2017 #2

- KAR alone affects the timing of seed germination.

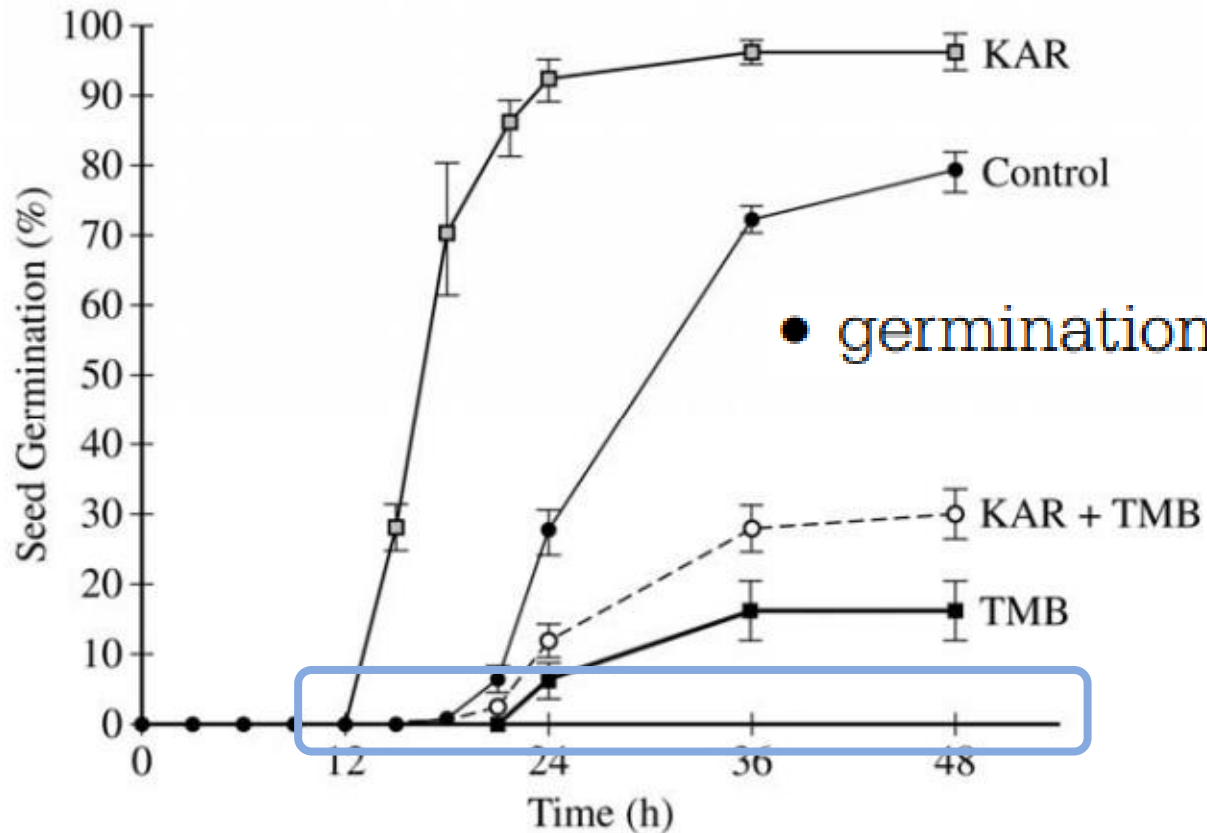


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .





# FRQ Friday #29

2017 #2

- KAR alone affects the percentage of seeds that germinate.

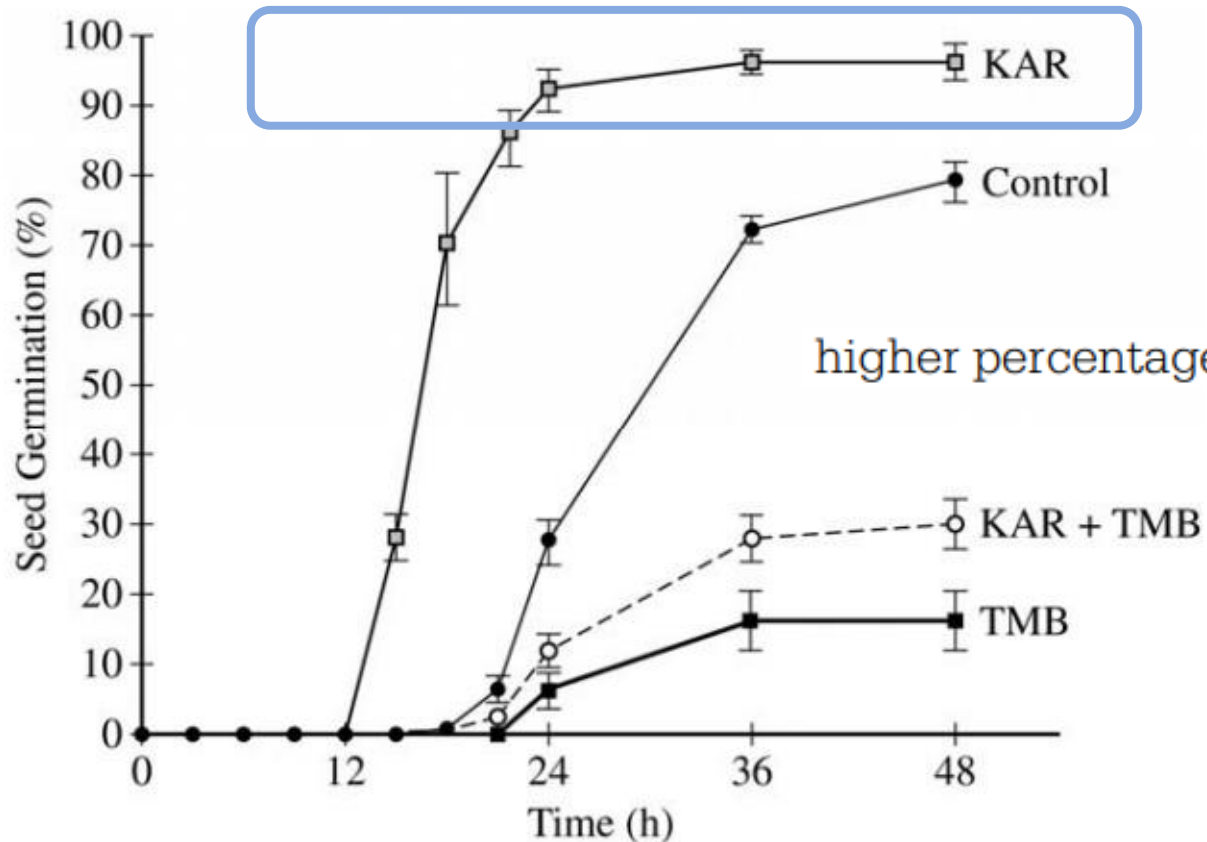


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .



# FRQ Friday #29

2017 #2

- TMB alone affects the timing of seed germination.

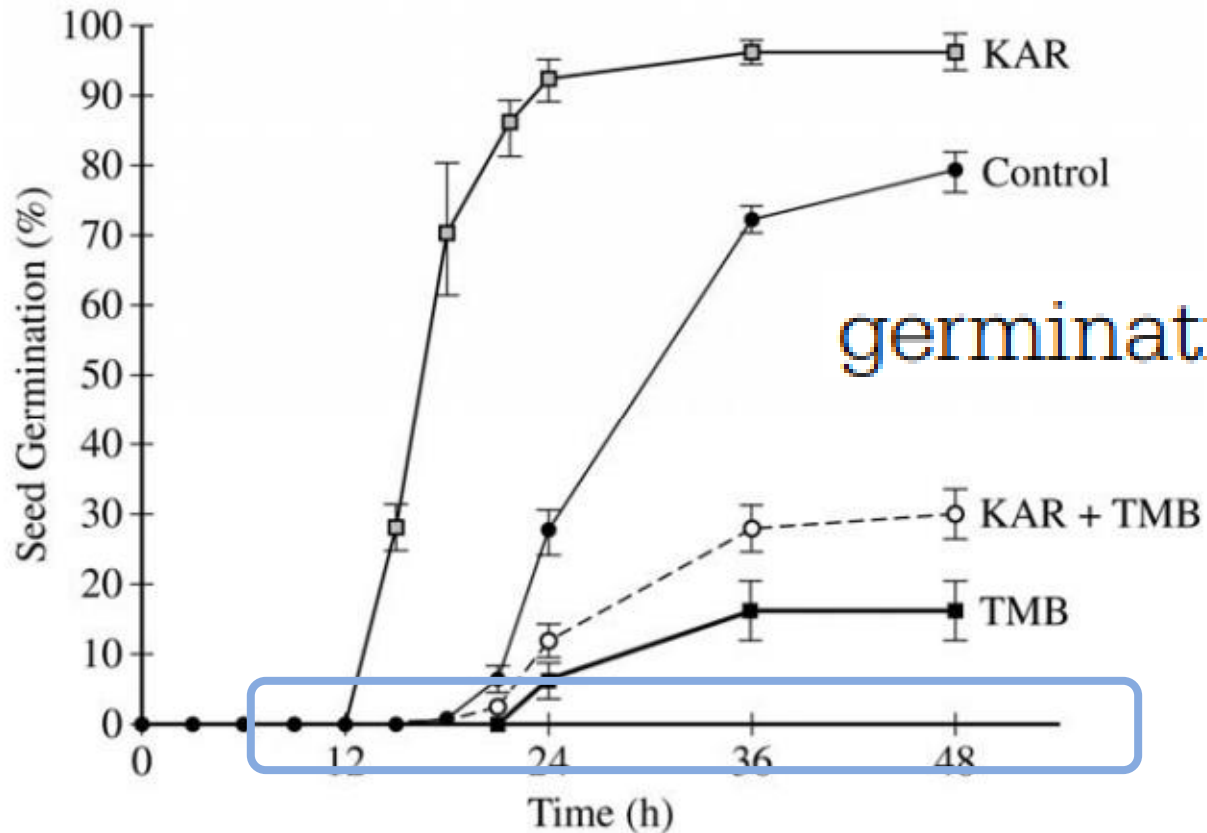


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .



# FRQ Friday #29

2017 #2

- TMB alone affects the timing of seed germination.

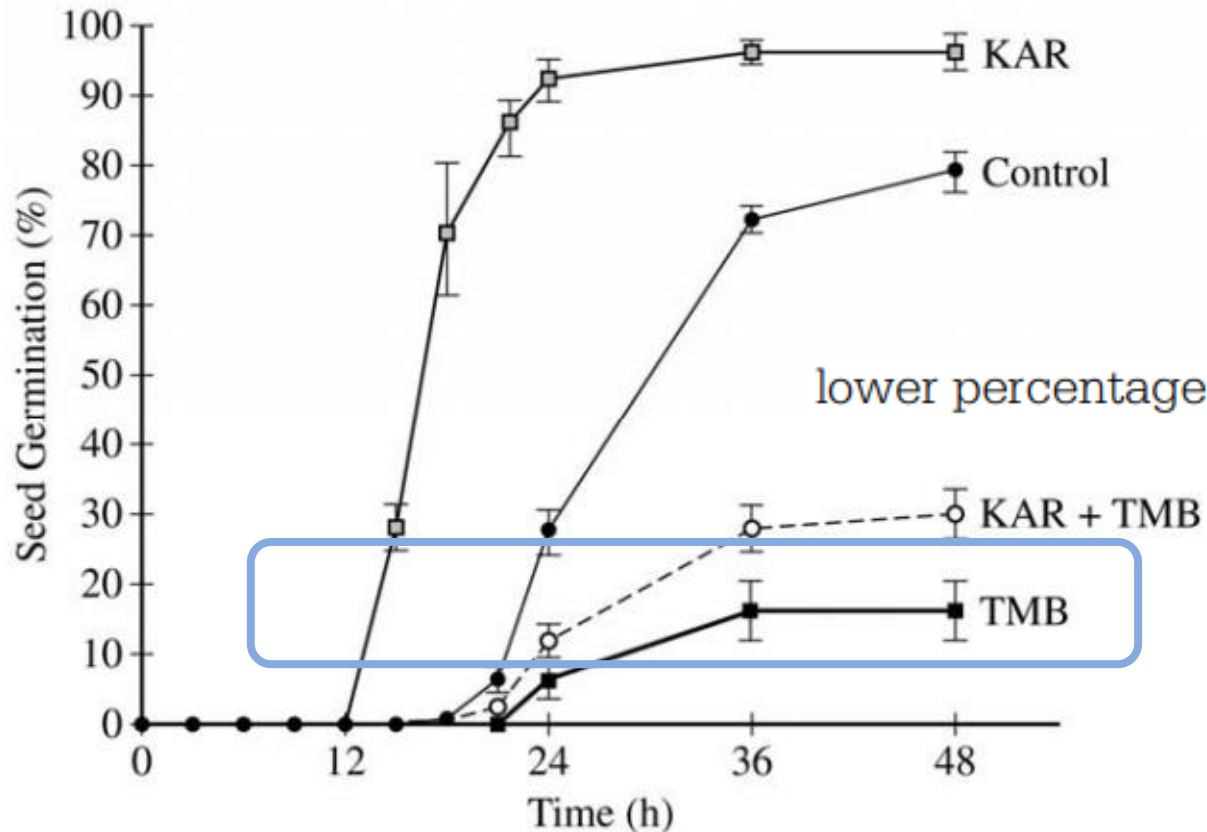


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent  $\pm 2SE_{\bar{x}}$ .



# FRQ Friday #29

2017 #2

Claim	Support (1 point each row; 4 points maximum)
KAR affects timing	• germination starts earlier/sooner/faster/quicker
KAR affects percentage	• higher percentage of seeds germinate in the presence of only KAR
TMB affects timing	• germination starts later/slower
TMB affects percentage	• lower percentage of seeds germinate in presence of only TMB

a) KAR affects the timing of seed germination, as seeds germinate 12 hours sooner than the control group.

KAR also affects the percentage of seeds that germinate, as 20% more seeds germinate than the control group.

TMB affects germination time, as seeds germinate 3 hours later than the control group.

TMB affects the percentage of seeds that germinate, as over 60% fewer seeds germinate than the control group.





# FRQ Friday #29

2017 #2

(b) **Make a claim** about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

Claim (2 points maximum; 1 point for KAR; 1 for TMB )		Support (2 points maximum; 1 point for KAR; 1 for TMB)			
<ul style="list-style-type: none"> <li>• KAR remains (bound after rinsing)</li> <li>• Rinsing does not affect KAR (binding)</li> </ul>	KAR with no rinse	KAR with rinse	different than	Controls	
	Group 2	Group 5		Group 1	Group 4

Group	KAR	TMB		Germination Result
1 (control)	-	-	-	Control result
2	+	-	-	Different from control
3	-	+	-	Different from control
4 (control)	-	-	+	Control result
5	+	-	+	Different from control
6	-	+	+	Same as control



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(b) **Make a claim** about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

Claim (2 points maximum; 1 point for KAR; 1 for TMB )	Support (2 points maximum; 1 point for KAR; 1 for TMB)				
<ul style="list-style-type: none"><li>• KAR remains (bound after rinsing)</li><li>• Rinsing does not affect KAR (binding)</li></ul>	KAR with no rinse	KAR with rinse	different than	Controls	
	Group 2	Group 5		Group 1	Group 4

b) Rinsing doesn't affect the binding of KAR to receptors. Treatment groups 2 and 5 are both treated with KAR, and, though treatment group 5 is rinsed, both behave differently than the control groups 1 and 4.



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2017 #2

(b) **Make a claim** about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

Claim (2 points maximum; 1 point for KAR; 1 for TMB )	Support (2 points maximum; 1 point for KAR; 1 for TMB)		
• TMB does not remain (bound)	TMB with no rinse	different than	Control
	Group 3		Group 1
• Rinsing affects TMB (binding)	TMB with rinse	same as	Control
	Group 6		Group 4

Treatment Group	Treatments		Rinsing	Germination Result
	KAR	TMB		
1 (control)	-	-	-	Control result
2	+	-	-	Different from control
3	-	+	-	Different from control
4 (control)	-	-	+	Control result
5	+	-	+	Different from control
6	-	+	+	Same as control



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(b) **Make a claim** about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

Claim (2 points maximum; 1 point for KAR; 1 for TMB )	Support (2 points maximum; 1 point for KAR; 1 for TMB)		
• TMB does not remain (bound)	TMB with no rinse	different than	Control
	Group 3		Group 1
• Rinsing affects TMB (binding)	TMB with rinse	same as	Control
	Group 6		Group 4

Rinsing does affect binding of TMB to receptors. Treatment groups 3 and 6 are treated with TMB. Treatment group 3 is unrinsed and behaves differently than control group 1. Group 6 is rinsed and behaves the same as control group 4. This shows that rinsing causes seeds with TMB to behave the same as the control group, showing that rinsing affects TMB.





# FRQ Friday #29

2017 #2

(c) There is intense competition by plants to successfully colonize areas that have been recently cleared by a fire. **Describe** ONE advantage of KAR regulation and ONE advantage of TMB regulation to plants that live in an ecosystem with regular fires.

## Description (1 point per row; 2 points maximum)

Advantage of KAR regulation

- Germination occurs at times of increased resources availability.
- Plants with KAR regulation can outcompete other plants (without KAR regulation).
- Germination occurs when fewer competitors are present/land is barren.

Advantage of TMB regulation

- Plants with TMB regulation do not germinate/can maintain seed dormancy until (enough) water is available.
- Plants with TMB regulation do not germinate in a dry environment.



# FRQ Friday #29

2017 #2

Description (1 point per row; 2 points maximum)	
Advantage of KAR regulation	<ul style="list-style-type: none"><li>• Germination occurs at times of increased resources availability.</li><li>• Plants with KAR regulation can outcompete other plants (without KAR regulation).</li><li>• Germination occurs when fewer competitors are present/land is barren.</li></ul>
Advantage of TMB regulation	<ul style="list-style-type: none"><li>• Plants with TMB regulation do not germinate/can maintain seed dormancy until (enough) water is available.</li><li>• Plants with TMB regulation do not germinate in a dry environment.</li></ul>

c) One advantage of KAR regulation in plants is that seeds germinate and begin to grow quickly after a wildfire, giving them first access to nutrients. One advantage of TMB regulation is that seeds grow again in the presence of water, so the seeds wait until a vital nutrient is present in order for them to grow better, is present.

